May 6, 1920

Engineering News-Record

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The Largest Structure of Its Type in the World

Methods of Sinking Large Open Caissons

Embankment and Concrete Work for Large Oil Reservoir

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

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Keep Pushing the Public Works Department

REPORTS from Washngton indicate that the campaign for a new Department of Public Works may have been too effective. So thoroughly has Congress been persuaded of the inefficiency of government administration that it proposes an entire revision of departmental functions and activities, as a first step to which bills have been introduced providing for the inevitable investigation which precedes every Congressional action. There is a great danger that the movement for a reorganization of Federal public works will have to await the slow process of a general reorganization. Washington needs reorganizing. President Taft recognized that; and the report of his commission, headed by Dr. F. A. Cleveland, is an admirable text on what is needed to be done. To appoint another commission now is only to postpone indefinitely the necessary reforms and to accumulate data that are already available. What is needed is action, not investigation, and the best initial action is the formation of a Department of Public Works. Other revisions can come later; it is only by slow steps that government methods are changed. The engineers who have been backing the Public Works Department idea must guard against this latest step which promises to nullify their progress.

Stealing Labor

WE COMMENTED April 1 upon the necessity of budgeting construction work to fit the available labor and materials supplies. An indication of the need for some such drastic procedure is afforded by the fact, recently come to light, that a Pennsylvania contractor who expects to begin work before long has for some time been subsidizing the common labor employed on other jobs in his vicinity. He is paying the men he expects to "lift" one dollar a day each while they are engaged in their present employment, with the understanding that when his work opens up they are to desert their present jobs and join his forces. Recently, also, we talked with an engineer who predicted that as soon as highway work again gets under way the project he is supervising will either be drained of men or wages will have to be put up sharply. He is working on a project essential to the safety of a large community. Its completion is certain to be delayed because of the mad scramble for the labor available.

Looking at the Other Fellow's Job

THE incidents recited in the preceding note point to the need of engineers looking beyond their own work and comparing its importance with that of other prospective construction in their localities. Seated in his own office, oblivious to the necessities in other lines of engineering, the paving engineer may be able to justify to himself a large construction program. The highway engineer, isolated in his turn, can demonstrate tremendous savings to the public from building hard-surfaced roads, while the water-supply engineer, on his part, realizing the imminence of a water shortage, can justify an extensive program. It is just this sort of thinking by isolated groups that is bringing about a construction crisis. Under these conditions, there is no certainty that the work most needed by the community will be done; rather, the agency that has or can get the most money, even if the work be a totally unnecessary one, will command the material and labor markets. If the Government or the United States Chamber of Commerce will not initiate the needed conferences, there is open an excellent opportunity for the engineering societies and the contractors' organizations of the country to help bring order out of chaos and confer a benefit upon the community.

New York Port Treaty Not Dead.

BARRING the remote chance of a special session of the New York Legislature and the passing of the New Jersey bill over the Governor's veto, the proposed interstate control of New York harbor must go over for at least another year. In spite of strong backing and its many commendable features, the reform involved is too radical for easy adoption. Some opposition arises from an honest demand that the interstate commission put forward a tangible scheme of port development before the extraordinary control be put into effect, but the temporary defeat of the idea is due entirely to selfish reasons. Jersey City, whom the Governor is representing rather than New Jersey as a whole, fears a reduction of tax income if a government body is substituted for the railways as the majority owner of its water front. The present administration in New York City simply cannot let go of any present control for possible future benefits. Perhaps the fact that within the year the Jersey shore will be the site of the largest port work the harbor has ever seen will serve as the writing on the wall to the New Yorkers, and a Jersey City man will not always be Governor of the State. The port treaty is by no means dead.

City Terminal Planning

AN ALL important phase of the modern city planning problem was ably presented at the National Conference on City Planning by Col. W. J. Wilgus, an eminent authority on railroad terminal problems, whose paper is printed in full on p. 901. Of the various elements of the city plan, the railroad terminal layout of any large city is probably the least susceptible to radical changes in arrangement because of the great expense involved and the intimate relation of existing freight facilities to the location of industries. The period of concentrating main-freight terminals at the business center of the large city is now passed, and congestion is forcing the stations and yards outward—shortening

the rail haul slightly and increasing the truck haul. Largely to avoid congestion of city streets with motor transfer haulage, Colonel Wilgus suggests building a subway system for distributing inter-city freight in small standard gage cars carrying demountable motor-truck bodies, similar to those used at Cincinnati for the inter-station movement of less-than-carload lots, as described in *Engineering News-Record* of March 11, 1920. For some extreme cases this radical step may well be justified, but where motor trucks largely displace horse drays, as in Cincinnati, the city may find that street congestion is relieved rather than increased by substituting a few motor trucks for a much larger number of drays. Colonel Wilgus's paper is striking evidence that the motor truck is gaining in recognition not as a competitor to rail transportation but as a partner capable of bringing out a greater usefulness of terminal facilities.

Poor Service Easily Attained

BETWEEN satisfactory and unsatisfactory service by a public utility there is a line which can be crossed in a day going down grade but back over which it may take years to climb. Such is the reasoning advanced by George G. Earl, general superintendent of the Sewerage and Water Board of New Orleans, in his recent annual report, in which he appeals for funds to anticipate the time when the capacity of the water filtration plant will be overtaxed and the 19-year-old pumping equipment of the extensive drainage system, which is fast becoming obsolete, will need replacing. There are literally hundreds of smaller municipal water plants in the Middle West which have been permitted to run too close or have already crossed the line into the zone of unsatisfactory service. Cities on the east side of San Francisco Bay have been on the line a long time. Chicago has had poor water service in some districts for years and Denver will be perilously close to a water famine this summer. In most cases the engineer has foreseen the danger and has done all in his power to awaken to action the fund-providing officials. The momentum of a great public utility going down hill is not easily overcome, and engineers should not hesitate to picture as vividly as they can the effect of poor service on the public.

Can the Rainy Day Hazard Be Eliminated?

IN attempting to visualize the extent of the road paving program in Iowa recently, F. R. White, chief engineer of the State Highway Commission, likened the task of building the State's 6,400 miles of primary road by present methods to filling with tincups 300 trains of fifty 10,000-gal. tank cars each.

Mr. White was trying to show the necessity for imagination and an inventive genius which will develop methods of laying roads in a continuous stream, *night and day, rain or shine, winter and summer.* We are far from that point now; few contractors figure on night work and none have yet attempted to house their operations so that even a summer shower may be weathered.

We shall come to these things—gradually, of course—but it does not seem a long stretch of the imagination to propose, at least, an equipment of a quarter of a mile of tent canvas which could be quickly erected over mixer, subgrade and stock piles. A light mounted steel frame might be drawn forward on the side forms with the canvas cover at the top partially spread in the day time for protection of the men from the sun. A simple intermediate step might be to cover the subgrade for a day's run ahead during storms.

The cost? Without stopping for figures, does it not appear likely to be offset by the savings accruing from constant use of organization and equipment?

In the efforts of engineers and contractors to get large mileage laid, factory methods must inevitably be adopted. Why not eliminate the weather factor by housing the plant? When men become available, why not light up the factory and run the machinery continuously? Stranger things than these may be seen before many months. Any method which will fill in the valleys on the progress chart will do more to keep red ink off the balance sheet than will occasional record days.

Riding Down With the Lowering Leaf

WHEN the new Michigan Avenue bascule bridge over the Chicago River was lowered into place for the first time a two-inch news item appeared in the *Chicago Tribune*. M. J. Faherty, president of the Chicago Board of Local Improvements, climbed to the top of the leaf and rode down with it. The reporter duly recorded the act and rightly so, for the early completion of the structure is due in large part to his indefatigable energy in pushing the work. If Mr. Faherty wanted to ride the lowering leaf he simply gave vent to his boyish enthusiasm in the most natural way. A correspondent who saw the news item, asks us the following questions: "Who designed the bridge? Who fabricated the steel? Who erected it, and why are these points of information less important to the general public than the circus stunt of riding down with the lowering leaf? Is the fact that the names of the men responsible for the design and successful construction of this bridge are omitted from the newspapers' account, indicative of a fundamental lack of news value in engineering work, or is it an indication of the lack of news sense on the part of the men whose names were omitted?"

So much has appeared in the Chicago newspapers about the bridge and when it would be finished that it is surprising the reporter got this much of a story since the structure will not be open to traffic before May 15, and the test of the leaf was made early in April. Probably that is all the reporter or the copy reader with his blue pencil thought the restricted news page could stand, but the designers, fabricators and erectors were not forgotten. In a five-inch editorial in a succeeding issue is an appreciation headed "Brawn Takes Its Profit from Brains" in which appear such sentences as the following: "Without the creative ability of the engineer there would have been no bridge for Chicago and no positions at high wages for those who did the manual work. The bridge is a monument to the general value of rewarding ungrudgingly those who contribute by their superior ability to the welfare of all." Perhaps Mr. Faherty inspired the reporter or got the engineer of the bridge to do so. He is that kind of a man. Truly, the engineers got a most generous share of praise even though their names were not given. This incident contains a lesson in engineering publicity which indicates that the newspapers are ready to do their part and it only remains for the engineers to learn their methods.

Representation at Organizing Conference

ATTENTION is called to the news article in this issue stating the basis upon which delegates to the Organizing Conference of engineering societies, to be held in Washington, D. C., next month, will be chosen. In its "call" to the meeting the Joint Conference Committee, representing the founder societies, made an error in announcing that societies, both national and local, would be allowed to send one delegate for from 100 to 2,000 members, and an additional delegate for each additional 2,000 members or major fraction thereof. As corrected, the delegate representation will be on a 1 to 1,000 basis (societies of 100 and less than 1,000 members being entitled to one delegate).

Following the defeat of Question 3 or the American Society of Civil Engineers' letter ballot canvassed April 14, there has been much speculation as to that organization's attitude with respect to the Washington meeting. It should be stated, therefore, in order to clear up any misunderstanding, that the American Society of Civil Engineers will be represented by delegates at the Organizing Conference, but these delegates will have no power to act for the society. They will be instructed along certain specific lines, as outlined in detail in our news pages last week. It is also definitely provided, by action of the society's Board of Direction, that the acceptance or rejection of any organization for the proposed federation of engineering societies in non-technical work be submitted, through the Board, by letter ballot to the membership. The membership last month registered its disapproval of the "comprehensive organization" outlined in the Joint Conference Committee's report. It will have another opportunity, however, to join with other national and local engineering organizations in any federation that may develop as a result of the Washington conference, or, if a negative vote is polled on the next letter ballot, to be a non-participant in such activities as may be undertaken. Certainly any federated movement of this country's technical bodies would be incomplete without the civil engineers, but it should be noted that the civil engineers are the only national organization in which the opinion of the membership on this subject of federation has been canvassed. In the case of the other founder societies, action on the report of the Joint Conference Committee was largely in the hands of the directors, not the individual members.

It will be particularly interesting, therefore, to observe the reception, by the membership of the founder societies, of any plan of federation which may take form at Washington, for it is idle to suppose that any of the national organizations could be committed to the project without a vote of the membership.

At this time it is useless to speculate on the outcome of the meeting. It will be an important gathering and one at which there should be a countrywide representation of delegates. Great influence would attach to any national federation of technical societies and, from the point of view of its political importance, it would carry more weight than an organization of individual engineers. Whatever decision may come out of the Organizing Conference will have a profound significance for the profession as a whole. It is the duty of engineers, therefore, to inform themselves thoroughly on the general subject of a federaton of engineering societies in order that, when the time comes, their decision may be based on sound, well considered judgment.

New Plan for Chicago Water-Works

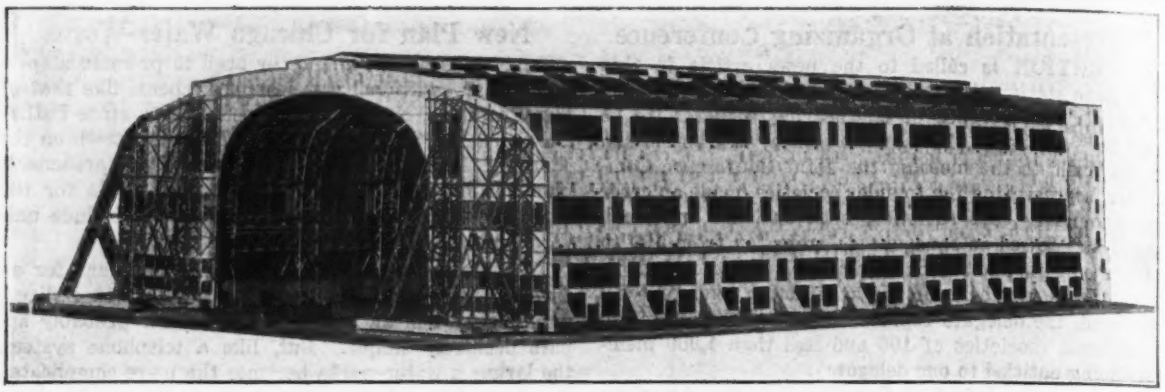
CHICAGO has no chance or need to promote a spectacular additional water-supply scheme like that of San Francisco, New York or Los Angeles, since Father Dearborn had the forethought to locate his town on the hore of Lake Michigan. However, a comprehensive plan has been projected (p. 844), as a guide for the next 35 years. Unfortunately it does not include universal metering.

To a Mulholland who has conceived the plans for an Owens River mountain supply the problem in a direct pumping system on a lake of pure water probably appars decidedly simple. But, like a telephone system, the larger a water-works becomes the more complicated it gets, and there is something more to the problem than adding a few pumps and new intakes. All pumps cannot be located economically on the lake shore; some must be placed inland to be near the center of the district they serve. Since gravity imposes a limit on suction possibilities, there is necessary a system of tunnels to the suction wells as well as one of force mains leading from the pumps. Economic limits in length and size are imposed on both systems, and with direct pumping maximum demand is the controlling factor in providing capacity.

In presenting this report, involving such enormous expenditures and enlargements, the city engineer has probably advanced the cause of water waste prevention much farther than the report of the Chicago Bureau of Public Efficiency of a few years ago, which indicated that one-half of the water pumped was wasted and that few new pumps, cribs or tunnels would be necessary if full metering were completed within ten years. But the present city administration does not favor full metering, and for that matter no past political administration in Chicago has favored it, although through the efforts of the American Association of Engineers the City Council in 1918 came within a few votes of adopting a full metering policy.

Since the powers that be will not furnish the means to stop the waste there is nothing else for the engineers to do but lay elaborate plans to continue to pump 300 gal. per capita, the fundamental basis of the plan. Rightly, the city engineer calls attention to the necessity of much rehabilitation and new equipment but to pump more water only to have half of it wasted is almost criminal. It certainly is not something of which to be proud. Once the overburdened tax payer is shown who is paying for that pumping, the Chicago City Council is likely to be told, in no uncertain terms, that appropriations for waste prevention rather than for new equipment will be in order.

The engineers of Chicago have a special duty in connection with this water waste situation, for the facts in the case are not easy to understand. The city engineer has come to them for assistance to check up on his plans. He has stated that if he is wrong he desires enlightenment; if he is right he wants and should have backing. If a no-metering policy is to be followed he is right, but *Engineering News-Record* believes in metering. The near approach to success in its campaign for metering made in 1918 by the American Association of Engineers indicates that renewed effort to convince the city officials of the reasonableness of selling water as well as gas by the cubic foot instead of by guess might prove successful.



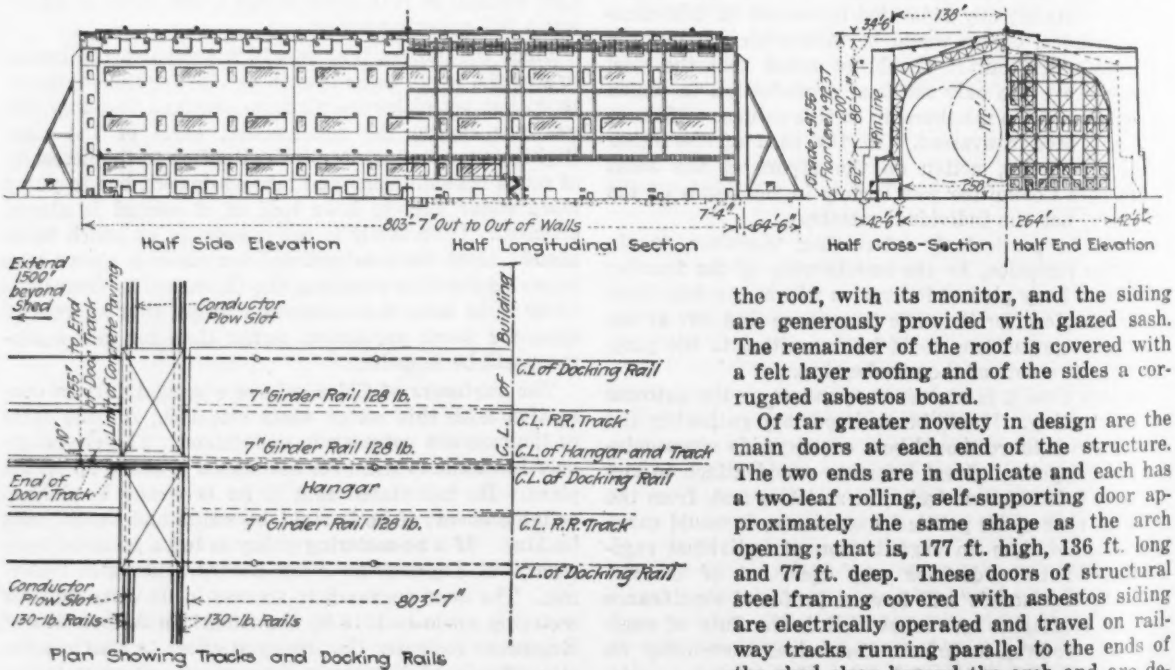
SMALL SCALE MODEL OF LAKEHURST HANGAR. NOTE FREIGHT CARS FOR SCALE

Navy Dirigible Hangar at Lakehurst a Huge Structure

Approximately 6.4 Acres Covered by Roof Arches Abutting on High Triangular Towers—803 x 360 Ft. in Plan and Arch Crown 172 Ft. Above Ground—End Doors Are Self-Supporting Structures

AT THE Naval Air Station, Lakehurst, N. J., the United States Navy is now building a hangar for rigid dirigibles which has the largest clear roof area of any structure in this country, and is the largest hangar in the world. The Lakehurst hangar, which is to be used to house the largest airships now being considered for the United States, and also as a constructing shed for new dirigibles, was designed in 1919 and will be completed some time this year. Its outside dimensions are 954 ft. in length out to out of doors and 350 ft. in width by 200 ft. in height, with clear inside dimensions of 803 ft. by 262 ft. by 172 ft. In order to provide the requisite clearance to dock and land the hugh airships, the clear height of the roof at crown is 172 ft. at the door and 195 ft. from the floor to the center of the pin. This is far greater than in any of the similar roof types used for armories, the nearest approach to the hangar in previous practice.

In design, the Lakehurst hangar roof is a series of three-hinged trussed arches, supported on high triangular towers. The ribs are in twins, spaced each 17 ft. 4 in. center, the bents themselves being 69 ft. 6 in. apart, with the roof and siding carried across that span on trusses. The outside siding follows the slightly inclined outer chord of the arch rib down to about the junction with the outer leg of the tower, at which point it extends as a roof over the space between the inner and outer siding of the towers. This space for the full length of the building on both sides is divided into two stories with rooms for office and shop purposes. As shown in the elevation and plan the roof, with its monitor, and the siding are generously provided with glazed sash. The remainder of the roof is covered with a felt layer roofing and of the sides a corrugated asbestos board.



GENERAL OUTLINE AND PLAN OF HUGE DIRIGIBLE HANGAR FOR U. S. NAVY AT LAKEHURST, N. J.

Of far greater novelty in design are the main doors at each end of the structure. The two ends are in duplicate and each has a two-leaf rolling, self-supporting door approximately the same shape as the arch opening; that is, 177 ft. high, 136 ft. long and 77 ft. deep. These doors of structural steel framing covered with asbestos siding are electrically operated and travel on railway tracks running parallel to the ends of the shed clear beyond the arch and are designed to take wind pressure on each side.

In addition to the structure proper, the hangar has three lines of railway inside and docking rails which pass through the shed and extend 1,500 ft. beyond each end.

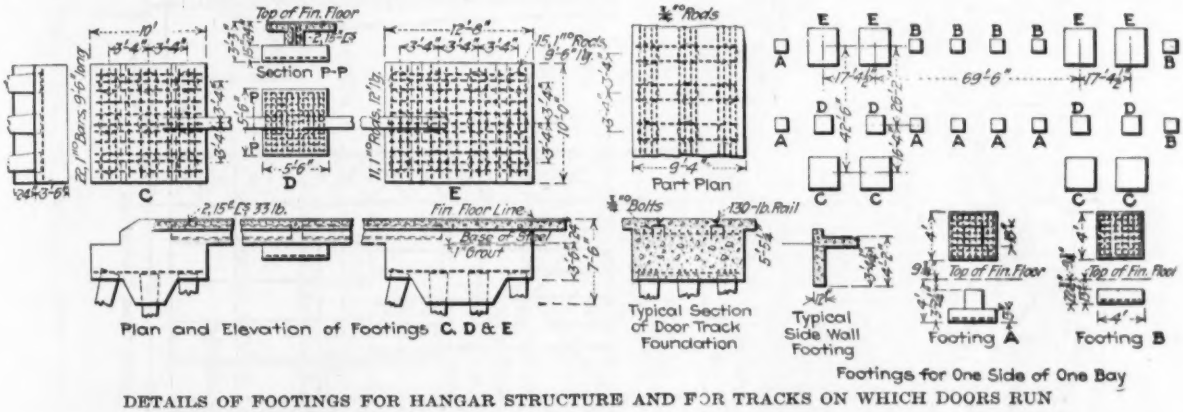
The shed is located in the ocean belt of New Jersey where the soil is dry sand capable of high bearing capacity when confined. In order to insure against movement, however, concrete piles are provided in all of the pier bases, stub piles under the main tower legs, and longer piles in the door foundations. As shown in the details of the footings herewith, there are separate concrete pedestals under each of the three legs of the tower with stub piles about 10 ft. long embedded in the outer and inner pedestals, the middle one with a lighter bearing requiring no piles. The outer row of piles in each pedestal is driven on a 1:4 slope. In addition, the three pedestals are tied together by concrete incased channels riveted to the legs of the tower. On the same drawing is a detail of the footing under the two tracks for the door,

All the stresses shown on the diagram, which were the designed stresses, were adjusted to a basis of 16,000 lb. per square inch. Further unit stresses are as follows:

Direction compression, rolled steel and steel castings	16,000
Tension, net section, rolled steel	16,000
Bending on extreme fibers of rolled shapes, built sections, girders and steel castings	16,000
Bending on extreme fiber of pins	24,000
Shear on shop rivets and pins	12,000
Shear on bolts and field rivets	10,000
Shear, average, on webs of plate girders and rolled beams, gross section	10,000
Bearing pressure on shop rivets and pins	24,000
Bearing on bolts and field rivets	20,000
Axial compression of gross sections for ratio of l/r up to 120	16,000—70 l/r
With a maximum of	13,000

The factor l/r shall not extend 100 for main members nor 120 for secondary members, nor 140 for bracing struts. For bracing subjected to tension l/r shall not exceed 200; l being the unsupported horizontal projection of the length of the member.

The structure is divided longitudinally in three sections by expansion joints just outside the main truss members as shown in the detail in an accompanying


Top of Fin. Floor
Section P-P
Part Plan
Plan and Elevation of Footings C, D & E
Typical Section of Door Track Foundation
Typical Side Wall Footing
Footing A
Footing B
Footings for One Side of One Bay

DETAILS OF FOOTINGS FOR HANGAR STRUCTURE AND FOR TRACKS ON WHICH DOORS RUN

each a continuous concrete base resting on 30-ft. straight concrete piles and carrying the tracks as an integral part of the structure. The pile spacing is based on a safe load capacity of 25 tons per pile.

The steel framing is not especially exceptional except in size. Each arch is a three-hinged type of rather simple trussing carried on the triangular trussed towers 64 ft. above the ground. The pin span is 264 ft. and the rise from pin to pin, 131 ft. Horizontal trusses at every other panel point carry the siding framing, and the roof framing is carried on longitudinal trusses at every panel, both outer and inner chords of the ribs being thoroughly cross-braced. All these details are shown on the sheet of details on page 894.

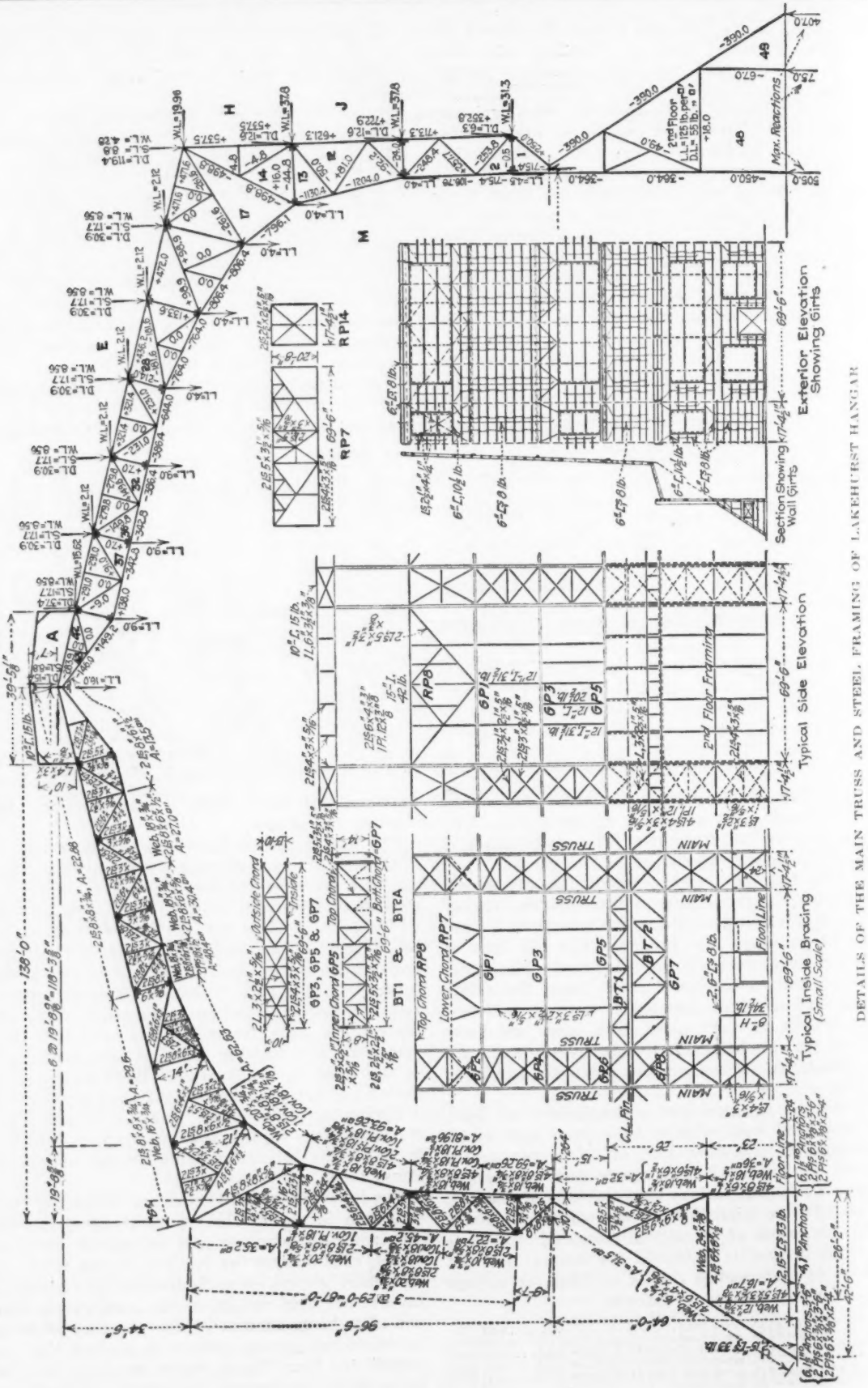
The shed is designed for a combination of dead, snow and wind load, with a basic dead load of 35 lb. per square foot, snow load of 20 lb. per square foot, and wind of 30 lb. per square foot. Investigation was made for various combinations of loading, as shown in the tabulation on the sheet of details, p. 895, for several of the typical members. The base unit stress in steel is 16,000 lb. per square inch, but as shown in the schedule this is modified for various combinations of loadings as follows:

For dead load plus 20 lb. snow load	Add 0
For dead load plus 30 lb. wind load	Add 10%
For dead load plus 20 lb. wind load plus 20 lb. snow load	Add 50%
For dead load plus 10 lb. wind load plus 40 lb. snow load	Add 50%
For dead load plus 30 lb. wind load plus 10 lb. snow load	Add 25%
For dead load plus 40 lb. snow load	Add 25%

drawing. At these joints a curved copper sheet is inserted for closure.

The details of the doors are shown in one of the drawings. At each end there are two duplicate right and left doors of the design shown. In effect they consist of a vertical frame 10 ft. wide and shaped to the arch opening, with an inside sheathing of asbestos board. This frame is carried on two standard-gage trucks, but its stability is assured by two diagonal braces extending back to another horizontal truss which rests on trucks traveling on another standard-gage track. The main frame is cross braced in the rear plane, the girt framing carrying the sheathing being in the front or inside plane. Wind loads are transmitted through the sheating to transverse trusses in a horizontal plane spaced every vertical 32 ft. and through them to the two rear braces which form in effect the triangular truss system shown in the stress sheet.

The lower horizontal trusses are encased in concrete, as shown in one of the typical sections, in order to give sufficient counterweight to balance the pressure of the wind against the full face of the doors. These horizontal girders were figured for the steelwork to support the dead weight of the steel during erection, and after being encased in concrete, they were figured as reinforced-concrete girders to support the counterweight, the lower flange angles becoming the reinforcing steel for the girders. The wind is figured in either

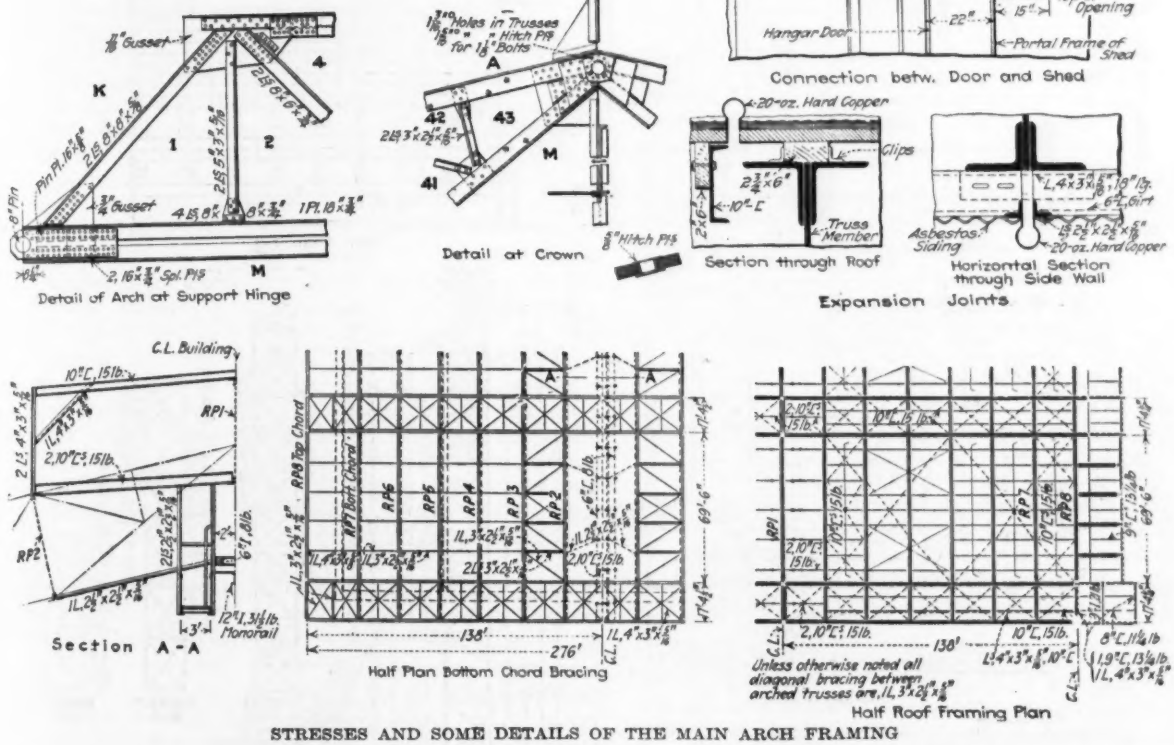


DETAILS OF THE MAIN TRUSS AND STEEL FRAMING OF LAKEHURST HANGAR

STRESS TABULATION FOR CERTAIN TYPICAL MEMBERS OF MAIN ARCH

– Denotes Compression + Denotes Tension

Member	D.L.	Snow	Snow Near	Snow Far	Wind Near	Wind Far	L.L.	D+L+W.	D+L+S.	D+L±S.	D+L±S+W.	D+L±S+W.	Max. Stress	Max. Stress as Basis of Design
								e 15,000 lb.	a 16,000 lb.	b 20,000 lb.	d 20,000 lb.	c 20,000 lb.		
M-1, M-2	-460.0	-176.0	-108.5	- 51.7	+ 94.0	- 91.0	- 91.0	-632.0	-717.6	-894.2	-808.0	-894.5	-720.6	-784.4
M-17	-435.0	-224.0	-115.0	-103.5	+142.0	-171.0	-112.1	-718.1	-769.1	-995.1	-942.1	-1052.1	-830.1	-796.1
M-32, M-33	-145.0	- 71.0	+60.0	-131.0	+208.0	- 213.0	- 59.5	-417.5	-335.5	-462.5	-548.5	-537.5	-493.0	-306.4
J-12	+251.0	+188.0	+86.0	+106.0	-218.0	+177.0	+171.0	+515.0	+506.0	+773.0	+763.0	+833.0	+669.0	+653.0
E-28	+161.0	+87.4	- 54.0	+138.0	- 389.0	+227.0	+68.2	+476.2	+387.2	+525.2	+614.2	+601.2	+545.2	+436.2
A-42, A-43	-109.0	- 71.5	- 77.0	+ 8.0	- 154.0	+ 12.0	- 33.4	- 316.4	- 239.4	- 316.4	- 393.4	- 367.7	- 354.9	- 293.9
12-13	- 41.5	- 11.5	- 8.0	0	+ 22.0	0	- 4.0	- 45.5	- 57.0	- 62.5	- 57.0	- 68.5	- 51.3	- 50.0
13-14	+ 35.0	+ 9.0	+ 8.0	0	- 55.0	0	+ 3.0	- 17.0	+ 47.0	+ 58.0	+ 47.0	+ 58.0	+ 42.5	+ 29.5
36-37	0	0	0	0	0	0	+ 0.7	+ 0.7	+ 0.7	+ 0.7	+ 0.7	+ 0.7	+ 0.7	+ 7.0
L-49	- 201.0	- 110.0					- 66.0			- 487.0				
M-48	- 254.0			- 41.0	- 199.0		- 11.0				- 505.0			- 492.0


Detail of Arch at Support Hinge
Detail at Crown
Connection betw. Door and Shed
Section through Roof
Horizontal Section through Side Wall
Expansion Joints
Section A-A
Half Plan Bottom Chord Bracing
Half Roof Framing Plan
Unless otherwise noted all diagonal bracing between arched trusses are, L 3"x2½"x5/16"

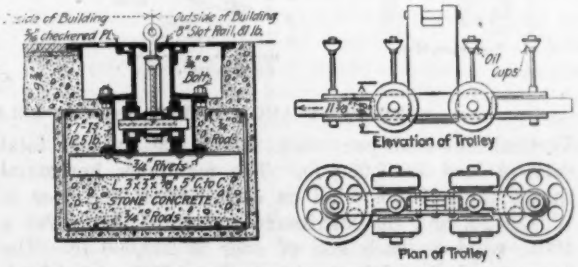
STRESSES AND SOME DETAILS OF THE MAIN ARCH FRAMING

direction, because when rolled out the doors are in the open exposed on both sides.

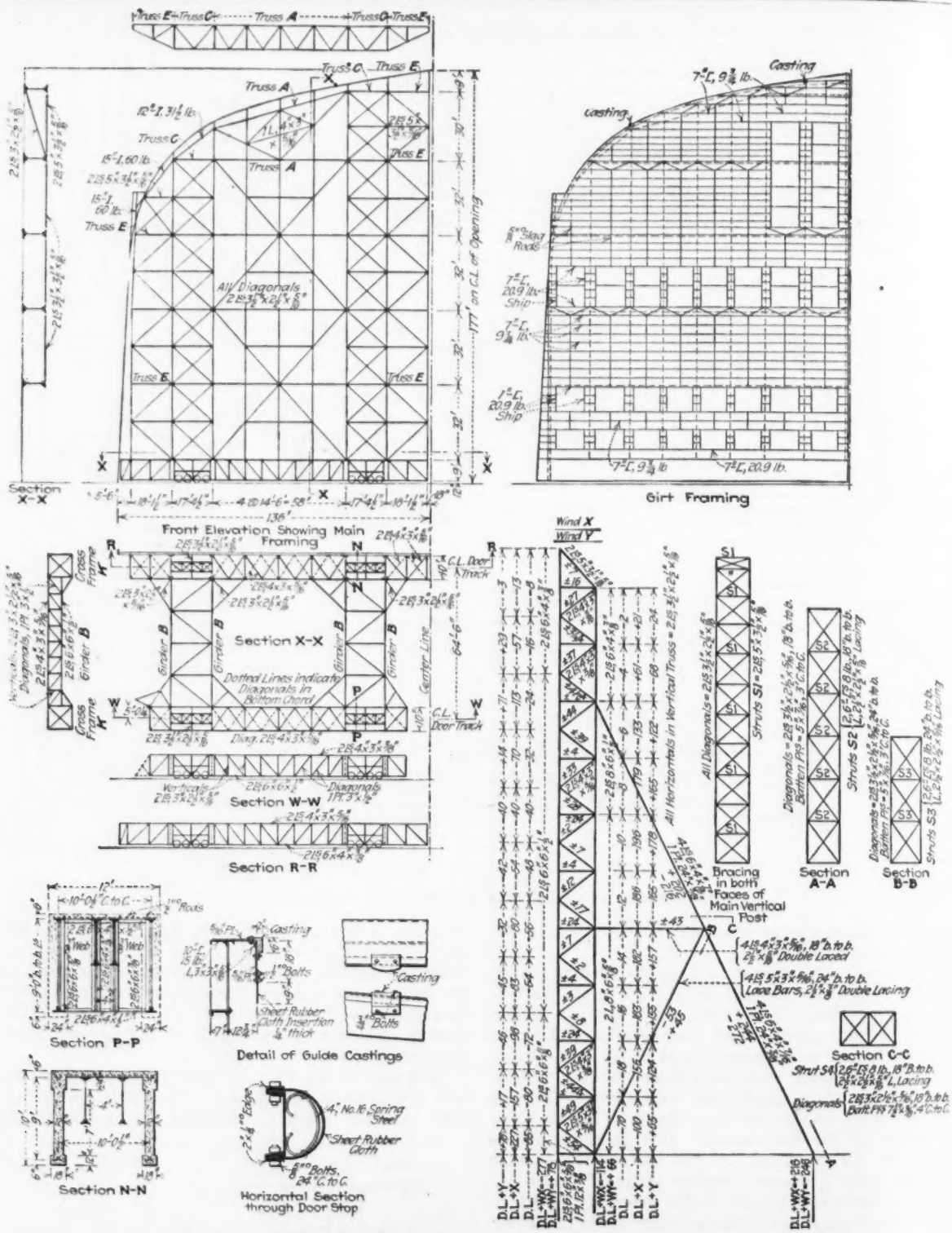
The doors are assumed to have no bending under the wind load, but at their upper face there are two castings provided, one near the crown and one at the haunch of the curve, which bear against horizontal channels framed into the portal arch of the shed. Here, too, an overhanging plate has pendant from it a sheet rubber cloth which drops down into a groove formed by a channel in the end arch frame so as to make a closure of the door above. This detail is shown in one of the drawings. At the bottom, the door is provided with a wooden weather strip, of 2 x 6 in. timber. The meeting faces of the doors at the center have a continuous semi-circular strip of sheet rubber cloth supported by 4 in. wide steel springs 3 ft. on centers. This will form a closure of the doors meeting at the center. The ends of the base framing where doors come together will have 12 x 12 in. timber bumpers to absorb the shock when doors come together.

These doors are, as stated, mounted on standard-gage trucks which travel on two lines of track laid on a concrete base. They are driven by electric motors with the power transmitted through plow which collects current from conductors in a slot. This slot or conduit, however, only approaches the outer edge of the door, so as to avoid possible fire risk of electric conductor near the open door of the hangar. The plow is carried in the extension of the forward lower truck of the door.

Each leaf of the door is supported on four trucks, each truck having eight wheels. The maximum vertical dead load per truck is estimated to be 562,000 lb.



DOCKING TROLLEY AND CONDUIT FOR LAKEHURST HANGAR



ELEVATIONS AND SECTIONS OF THE SELF-SUPPORTING DOOR TO LAKEHURST HANGAR

Vertical live-load per truck is 496,000 lb. and total vertical load 1,058,000 lb. The maximum horizontal thrust for a 30-lb. wind on each leaf of the door is 720,000 lb. and the maximum horizontal thrust for a 10-lb. wind on each leaf of door is 240,000 lb. The doors are designed to operate under a 10-lb. wind load. In addition to the electric drive, an emergency winch with cables for hand operation is provided to open and close the doors in case of the failing of the current or motor.

The entire clear floor of the hangar is to be of asphalt block on an 8-in. concrete base. Other floors, notably the office and service rooms, are to be of concrete, tile or wood flooring on concrete. Expansion

joints in the floor base of the main portion of the building are to be provided at the junction of the floor with the longitudinal curb under the interior partitions, and transverse joints will be provided every 40 ft., the joints to come on truss lines.

An interesting feature of the shed are the docking rails. These are placed running through the shed and extending beyond 1,500 ft. at each end. They are in effect conduits with narrow slots through which lines reaching from a trolley inside the conduit can be extended to the airship being launched or docked. The section through one of the conduits is shown herewith, this being similar in general detail to the ordinary trolley or conduit construction with slots except that provision has to be made for the uplift of the airship against the under face of the slot. A trolley of special design, also shown, is provided which when not in use rolls along the bottom track in the conduit but when in use for docking or launching rolls on its upper bearing on the under side of the slot rail. There was considerable difficulty in designing a detail of the crossing of this launching conduit with the door tracks. It was felt to be necessary to provide some closure of the slot during the passage of the door trucks because of the shock to so large and heavy a structure by the jolting over this opening. Accordingly, a special detail, not shown in the drawings herewith, was designed in which at each crossing of rail with slot there is a moving rail which can be thrown by interlocked connecting rods tying together all of the crossings. When the doors are not in use, this rail leaves the slot open for the passage of the trolley and guys and lines to the airship. When the door is about to be moved, the connecting rod is thrown and the rails move up to fill up the slot opening and provide a continuous track for the door.

Special attention had to be paid to the lighting of the shed because of the possible presence there of an explosive mixture due to the escape of hydrogen from the dirigible. Therefore, no wires or exposed connections are taken inside of the shed. All lighting is through heavy glass covers in walls and floor and roof, with the connections well outside the structure and with gasproof glass covers. On account also of the gas which is used to fill the balloons, the lights in the skylights are of actinic glass which will cut out the detrimental rays.

Special provision for working in the shed is made by a number of so-called catwalks, which are horizontal balconies running along under the roof. Fastenings are placed at the various roof rafters for traveling hoists. These added considerably to the designed loads on the roof.

Special attention is paid the architectural features of the shed. In so huge a structure this was difficult, but the architectural design was aided considerably by the building of two successive models, a view of one of which is shown herewith. By the use of this model the design of the doors was improved considerably. Under the present design, the curve of the upper part of the door is so made that when the door is open it forms a continuous and pleasing line from the monitor down to the edge of the door.

The hangar was designed by the Bureau of Yards and Docks under the direction of Rear Admiral C. W. Parks, Civil Engineer Corps, U. S. N., Chief of Bureau, and Commander Kirby Smith, C. E. C., U. S. N., Project Manager. J. Michaelson had charge of the engineering computations, and Wm. Partridge developed the architectural details.

How Wisconsin University Assists Owners and Engineers in Land Drainage

THAT land drainage can be stimulated by practical demonstration was shown at the recent annual meeting of the American Society of Agricultural Engineers, at Chicago, in a paper by E. R. Jones, chairman of the department of agricultural engineering of the University of Wisconsin and also state drainage engineer.

In a community where several landowners are considering drainage, the Wisconsin College of Agriculture will lay out a drainage system on one farm, staking the lines and establishing grades and explaining the methods at a meeting of landowners. This service is free but is limited to communities that need object lessons, while the person served must agree to engage a private engineer to insure proper construction according to the plans recommended. In this way the farmers are taught to help themselves in the simpler projects and to engage engineers for the larger ones.

At first engineers were inclined to object to this service, but it has been found to increase directly the demand for their services. In one case, the result of a demonstration was the use of 15 carloads of tile in one season in a district which previously had no tile drainage, while an engineer in that district now has all the work he can handle in laying out drainage systems for farmers. In order to eliminate communities which might ask for demonstrations merely out of curiosity, the service is restricted to places where the landowner agrees to install the system as laid out. He is expected also to advertise the demonstration so as to have a large attendance.

Three other lines of activity of the College of Agriculture were noted by Mr. Jones. One of these is in advising landowners in cases where the drainage outlet would be through the lands of unwilling owners, a law passed in 1919 providing that in such cases the willing owners must petition the circuit judge for a drainage district and must accompany the petition with plans showing specified features. The engineers of the college will help the owners to decide whether a district organization is desirable and how much land should be included. This service is free but is rendered at such times as will involve the least expenditure of time and money.

Reports are made on all drainage districts that are organized and under another law of 1919 these reports are now submitted to the state chief engineer, who has power to prevent the organization of projects on poor lands and the execution of faulty plans on any lands. The agricultural engineer of the college is made state drainage engineer, by whom both preliminary and final plans and all assessments must be approved. There is little friction in this procedure, as the various engineers keep in touch with the college and take its suggestions, so that the final plans usually are in such shape as to be readily approved. The College of Agriculture is in close coöperation with the state drainage association, which has nearly 400 members and holds a winter convention and a summer field meeting each year.

Municipal Engineers' Salaries Proposed by A.A.E.

THE accompanying schedule of salaries of engineers in municipal service, prepared by a committee of the American Association of Engineers headed by S. C. Hadden, is the third national schedule for engineers in public service issued by the association. Schedules for state and for county highway engineers have been endorsed in final form by the board of directors of the association, but the municipal schedule is still in tentative form and is issued now for the criticism of the profession.

The preparation of these three schedules has been under the direction of the committee on salaries of engineers in public service, of which A. N. Johnson, consulting highway engineer of the Portland Cement Association, is chairman. Mr. Johnson and the rest of his committee with the assistance of a large number of corresponding members prepared the schedules for state and county highway engineers. The municipal schedule was prepared by a sub-committee headed by Mr. Hadden.

The municipal schedule is expected to be adopted at the next meeting of the board of directors on May 9 at St. Louis. Criticisms are requested to be sent to S. C. Hadden, 63 East Adams Street, Chicago, before that time.

RECOMMENDATIONS FOR SALARIES FOR ENGINEERS IN MUNICIPAL SERVICE PROPOSED BY AMERICAN ASSOCIATION OF ENGINEERS

Schedule 1

Cities up to 15,000 population

City Engineer—In charge of all engineering work of the city except water works	$ 3,500	$5,200
First Assistant Engineer—Duties as assigned; no executive work	2,400	3,000
Second Assistant Engineer—Performs or has charge of drafting and surveying work	1,800	2,400
Rodman and Chainman	1,200	1,600
Inspector on Construction Work—First Class	2,400	3,000
Second Class	1,200	1,600
Superintendent of Water Works—In charge of maintenance, operation and extension of water works system	1,800	3,600
Superintendent of Streets and Sewers—In charge of maintenance of city streets and sewers	1,800	3,000

Schedule 2

Cities from 15,000 to 50,000 population

City Engineer—In charge of all engineering work of the city, except water works	4,800	6,000
First Assistant Engineer—Duties as assigned but responsible for office engineering work	2,400	3,600
Second Assistant Engineer—Chief of Survey Party and Supervising Engineer on Construction	2,400	3,600
Instrumentman	1,800	2,000
Draftsman	1,800	2,400
Rodman, Chainman and Tracer	1,200	1,600
Inspector on Construction Work—First Class	2,400	3,000
Second Class	1,200	1,600
Superintendent of Water Works—In charge of maintenance, operation and extension of water works system	3,600	5,000
Superintendent of Streets and Sewers—In charge of maintenance of city streets and sewers	2,400	4,000

Schedule 3

Cities from 50,000 to 100,000 population

City Engineer—In charge of all engineering work of the city, except water works	5,500	7,500
Deputy City Engineer—Office engineering and special work as assigned	3,200	4,800
Division Engineer—In charge of surveying operations and supervision of city construction work	3,000	4,500
Assistant Engineer—Reports to division engineer and acts as chief of party or construction superintendent	2,600	3,600
Instrumentman	2,200	3,000
Draftsman	2,200	3,000
Rodman, Chainman and Tracer	1,500	1,800
Inspector on Construction Work—First Class	2,600	3,200
Second Class	1,500	1,800
Superintendent of Water Works—In charge of maintenance, operation and extension of water works system	4,500	6,000
Superintendent of Streets and Sewers—In charge of maintenance of city streets and sewers	3,600	4,800

Schedule 4

Cities from 100,000 to 300,000 population.

Department Commissioner—Commissioner of Department of public works or head of special commission as on transportation, sewage disposal, additional water supply or other similar work of the first magnitude	7,500	10,000
City Engineer—In charge of all engineering work of the city, except water works	7,000	8,500
Deputy City Engineer—Principal assistant to city engineer assigned to special work	4,800	6,400
Division Engineer—In charge of major subdivision of the city engineering work such as pavements, sewers, bridges, etc.	4,000	4,800
Office Engineer—In direct charge of design, reporting to division engineer	3,600	4,000
Assistant Engineer—First Grade	3,200	3,800
Second Grade	2,800	3,100
Reports direct to division engineer and acts as chief of party, squad-leader or construction superintendent.		
Testing Engineer, Chemist or Bacteriologist—In charge of testing work in construction material laboratory, water purification plant or sewage treatment plant	3,200	3,800
Instrumentman	2,400	3,200
Draftsman—First grade	2,400	3,200
Second Grade	1,800	2,100
Rodman, Chainman and Tracer	1,700	2,000
Inspector on Construction Work—First Class	2,800	3,400
Second Class	1,700	2,000
Superintendent of Water Works—In charge of maintenance, operation and extension of water works system	5,000	7,000
Assistant Water Superintendent—In charge of domestic distribution system	3,600	4,800
Water Works Mechanical Engineer—In charge of pumping plants of city water works	3,600	4,800
Superintendent of Meters and Services—In charge of installation of water meters, service pipes and meter reading	3,600	4,800
Superintendent of Water Filtration—In direct charge of city water purification plant	3,600	4,800
Superintendent of Streets—In charge of maintenance of street, including street cleaning and refuse collection	3,600	4,800
Superintendent of Sewers—In charge of sewer maintenance, repairs and new connections	3,600	4,800
Superintendent of Sewage Disposal—In direct charge of sewage disposal plant operation	3,600	4,800
Superintendent of Refuse Disposal—In charge of municipal refuse destructor or incinerator	3,600	4,800

Schedule 5

Cities from 300,000 to 500,000 population.

Department Commissioner—Commissioner of department of public works or head of special commission as on transportation, sewage disposal, additional water supply or other similar work of the first magnitude	10,000	15,000
City Engineer—In charge of all engineering work of the city, except water works	9,000	12,000
Deputy City Engineer—Principal assistant to city engineer assigned to special work	6,000	7,500
Division Engineer—In charge of a major subdivision of the city engineering work such as pavements, sewers, bridges, etc.	4,200	6,000
Office Engineer—In direct charge of design, reporting to division engineer	3,800	4,200
Assistant Engineer—First Grade	3,400	4,000
Second Grade	2,900	3,300
Reports to division engineer direct and acts as chief of party, squad-leader, or construction superintendent.		
Testing Engineer, Chemist or Bacteriologist—In charge of testing work in construction material laboratory, water purification plant or sewage treatment plant	3,400	4,000
Instrumentman	2,400	3,200
Draftsman—First Grade	2,400	3,200
Second Grade	1,800	2,100
Inspector on Construction Work—First Class	2,800	3,400
Second Class	1,700	2,000
Rodman, Chainman and Tracer	1,700	2,000
Superintendent of Water Works—In charge of maintenance, operation and extension of water works system	7,500	10,000
Assistant to Water Superintendent—In charge of domestic distribution system	4,800	6,000
Water Works Mechanical Engineer—In charge of pumping plant of city water works	4,800	6,000
Superintendent of Meters and Services—In charge of installation of water meters, service pipes and meter reading	4,800	6,000
Superintendent of Water Filtration—In direct charge of city water purification plant	4,800	6,000
Superintendent of Streets—In charge of maintenance of streets, including street cleaning and refuse collection	4,200	6,000
Superintendent of Sewers—In charge of sewer maintenance, repairs and new connections	4,200	6,000
Superintendent of Sewage Disposal—In direct charge of sewage disposal plant operation	4,800	6,000

Superintendent of Refuse Disposal—In charge of municipal refuse destructor or incinerator	4,200	6,000
City Managers—Where a City Manager is employed his position shall be defined as the Administrative head of the municipality, appointed by its Legislative Body, and his duties make him the head of the service, safety, health, and welfare departments of the city. The following salaries are proposed for City Managers:		
Schedule 1	5,000	7,500
Schedule 2	7,000	8,500
Schedule 3	8,500	10,000
Schedule 4	10,000	12,000
Schedule 5	12,000	15,000

These schedules not to operate to reduce any existing salaries.

Zoning of Portland, Ore.

ZONING ordinance, dividing the city of Portland, Ore., into eight use and six height districts and containing also some provisions as to the portions of lot that may be occupied by each building has been adopted by the City Council. The ordinance is subject to approval at the general election—November, 1920.

The eight use districts are in three general classes. Residence districts include Class 1, single family dwellings, and Class 2, all kinds of dwellings. Business and public use districts include (3) retail business, offices and dwellings; (4) public and semi-public uses; (5) wholesale and retail business and dwellings, and (6) hospitals and institutions. Industrial districts embrace (7) ordinary factories and warehouses without dwellings; (8) noxious industries without dwellings.

The height districts provide for buildings of 2½, 3, 4, 6, 8, and 10 stories in height, with height limits of 38, 42, 60, 85, 105, and 130 ft. These heights may be exceeded for such towers, spires, gables and tanks as have areas not exceeding 15 per cent of the area of the lot and base areas greater than 2,500 sq.ft. Church spires, chimneys, flag poles and wireless towers are excepted. Special provisions govern the distance of high buildings from the street and permit dormers above the height limit provided these are not more than 60 per cent of the length of the building at such height limit, and that the length must be decreased by 1 per cent for each additional foot in height.

In the home area districts not more than 40 per cent of the area of any lot may be occupied by a building at grade, and not more than 30 per cent at an elevation 16 ft. above grade.

In use districts 3, 4, 5, 7 and 8 a rear yard must be provided having a minimum depth of 8 ft. and increasing by 2 in. for each 1 ft. of height of building.

Amendments and changes in district lines may be made by the Council on request of property owners if approved by the City Planning Commission after public hearings have been held by the Commission and the Council. Charles H. Cheney is the consultant engineer to the commission.

Air Agitator Speeds Floc Formation

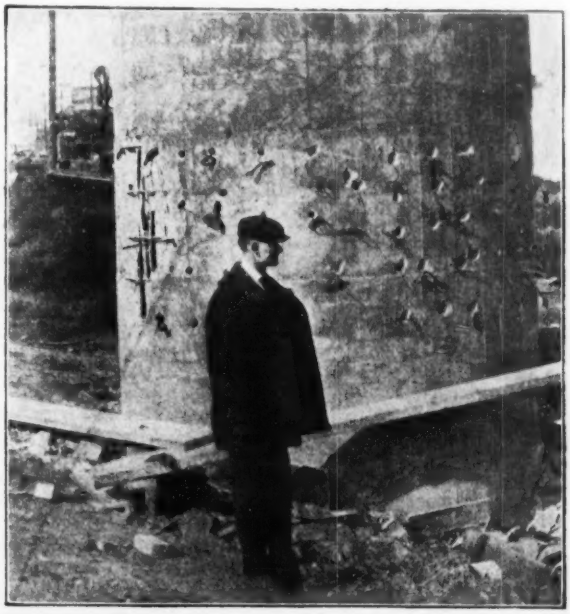
To hasten the formation of a "floc" in the sedimentation basin of the Bridgeton (N. J.) water filtration plant during floods when the turbidity is high and alkalinity low, compressed air is introduced at a point near the entrance to the basin. The air is distributed from a horizontal perforated pipe extending across the basin several feet below the surface. A violent agitation is obtained, which, according to a recent issue of the New Jersey Public Health *News*, satisfactorily coagulates the chemical within the first 15 ft. of the 115-ft. travel in the basin, thus permitting setling within the 1¾ hr. detention period.

Felling A Concrete Chimney

Nearby Structures Made Necessary a Complicated Procedure of Blasting and Tug Lines To Avoid Danger

By A. D. Butler
City Engineer, Spokane, Wash.

BECAUSE of the existence of buildings very close to a 210-ft. reinforced-concrete stack in the city of Spokane, Wash., the necessary felling of the chimney, which had become obsolete, involved considerable difficulty. After a legal controversy as to the responsibility for the demolition, a method of felling was adopted which proved successful, although it was somewhat complicated.

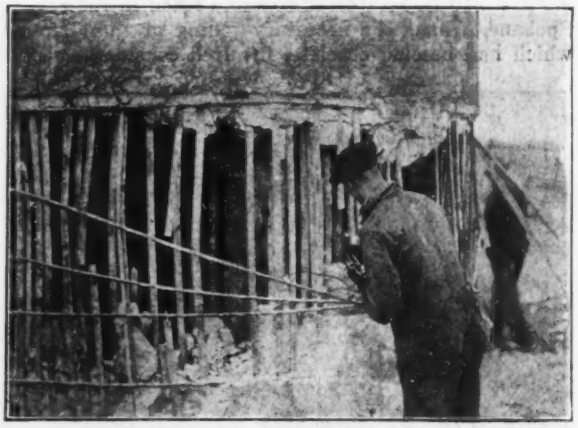


DRILL HOLES IN STACK PREPARATORY TO BLASTING

In order to widen their yards the Spokane and Inland Empire Ry., in 1915, proposed an exchange of property with the city of Spokane, the railway company taking over the property on which the crematory buildings stood and paying for their moving and rebuilding on a strip of ground adjoining their former site on the north, the transaction carrying with it the necessary transfer of property.

Accordingly a new modern crematory was built on the new site, using the incinerators, brick and other movable parts of the old building. It was impracticable to move the old stack; hence, a new stack was built and the old one left where it stood. This old stack was of concrete heavily reinforced, 9 ft. 10 in. in diameter at the base, 210 ft. high and weighing about 200 tons. The city, bowing gracefully to the railway company, said: "You may have the stack." The railway company, bowing back, entreated the city to take it away. The proximity of the new crematory buildings on the one side and the Inland yards on the other made the removal of the stack unusually hazardous; since if the stack should fall to the south it might do several thousand dollars damage to railroad property, while if it fell to the north it might do at least $20,000 damage to the new crematory.

This Alphonse and Gaston attitude of the city and railway company over who should have the privilege of removing the stack, led to a law suit which dragged on for about two years, during which time a great deal of correspondence was had with many contracting firms concerning its removal. Some firms made personal inspection of the stack and its location, and al-



CUTTING THE REINFORCEMENT WITH GAS FLAME

though there were some offers to do the work none of them would assume any liability for damage.

The decision of the court left the burden for the removal of the stack on the city. The city council therefore ordered the engineering department to proceed to remove it by day labor.

By observations with transit it was discovered that the structure leaned slightly to the south and east. With this in mind a dead-man was anchored somewhat north of the direction in which it was hoped to fell the stack, endeavoring in this way, if possible, to counteract the tendency of the stack to go too far south, which might endanger the railroad property.

An attempt was first made to shoot a line over the top of the stack with a gun used for the purpose by the fire department; but the 200 ft. vertical height proved too great, so a light scaffold was built up on the inside to a height of 100 ft., a hole was put through the shell of the stack, and a ¾-in. cable fastened securely to another anchor on the inside. The cable was then fastened to a 1-in. manila line, which passed through a double and triple block which was fastened to a deadman. The line was thence run at right angles a distance of about 50 ft. to the drum of a windlass. The windlass, acting in conjunction with the set of blocks would develop a strain on the cable of about twenty tons. It was observed that when the cable was stressed to a maximum, the top of the stack could be drawn over about 1 in. Sixty-five holes were drilled around the stack in a belt about 4 ft. wide on the side in which it was desired to have it fall, leaving about one-third of the circumference untouched except for several emergency holes which were drilled to be used in an extreme case. Owing to the large quantity of steel reinforcing in the stack, considerable trouble was experienced in drilling these holes.

After the drilling was completed, the wind being favorable, the work of blasting the concrete away was begun. On the north side of the stack was an opening 4 ft. wide and 7 ft. high, through which the smoke flues had entered. In order to keep the section symmetrical, an opening was first blasted out directly opposite this one, then a similar opening was shot out in the direction toward which it was desired to fell the stack, leaving two sections calculated to act as columns and amply sufficient to support the weight to which they would be subject. They were left as nearly symmetrical as possible in order not to permit the stack to settle out of line. These piers were loaded and shot simultaneously, but although the stack listed about 6 in. in the direction of the cable, it did not fall, being supported only by the reinforcing steel and one-third the circumference. An acetylene torch was then employed to cut the steel reinforcing bars, and although this also permitted the stack to be drawn over a few inches more out of line, yet it resisted all the strain that could be thrown into the cable by taking up the slack in the cable after each shot was fired.

It was possible by this time, however, to throw the stack out of line in the proper direction altogether about 2½ ft.

It was now thought safe to load and shoot the emergency holes on that portion of the circumference still untouched. By the shooting of these holes there was left only about 4 ft. or one-seventh of the concrete ring intact. After shooting these holes, the stack started slowly to fall in the direction in which the cable was attached.

The cable was quickly tightened and determined the direction of the fall. When the stack had tilted over at an angle of about 30 deg. the segment of concrete left on the back broke, permitting the stack to drop back, which broke all the reinforcing, after which it fell very rapidly.

Due to its initial leaning to the south, the general direction of the stack was about 10 deg. south of the direction in which the cable was pulling. The upper

BASE OF STACK AFTER FALLING

two-thirds of the stack completely collapsed, burying itself in the soft ground.

The total cost of felling the stack, including labor, staging, lines, powder, etc., was $274. The total time actually spent was five days with a crew of four men.

Relation of Railroad Terminal Problem to City Planning

By WILLIAM J. WILGUS

(Paper Delivered Before National Conference on City Planning)

THE RAILROAD problem may be said to embrace three separate and distinct phases: That having to do with passenger and freight traffic destined for local distribution; that dealing with direct movements to and from local industries and other facilities having their own side tracks; and that having to do with the interchange of traffic destined for points beyond.

In discussing the first of these phases, which has to do with the local distribution of freight and passenger traffic, it should be borne in mind that the railroad terminal is not such in the sense that the movement of either freight or passengers there terminates. The terminal is merely a step in the journey between the point of origin and that of final destination, where the passengers or freight are transferred from one means of transportation to another. Stated differently, the terminal is to be considered as a means of transition from one transportation agency to another. It is a terminal only for the vehicles employed in effecting a portion of the journey of their contents. The passenger, on arrival at the terminal, alights from his train and continues therefrom by vehicle or on foot to his residence or place of business; and the article of freight is transferred from the freight car to the truck that is to effect the final delivery.

It has seemed well to dwell somewhat on this feature so as to remove from the mind the idea that the railroad terminal is really a terminal for the object that is being transported. Having that idea firmly in mind, it is possible to discuss more clearly alternative solutions of the terminal problem.

In the early stages of the growth of the American city there were no rapid transit facilities quickly and cheaply to convey the passenger from the terminal to his home or place of business, and land for terminal purposes was comparatively cheap. Therefore the station was placed as closely as possible to the business center of the community. Similarly, the comparative cheapness of property, coupled with the slowness and limited radius of action of horse-drawn trucks, led to the placing of local freight terminals adjacent to the business center.

In the course of time conditions in these particulars have radically changed. Our cities have shown a remarkable increase in population; the property occupied for railroad terminals has become extremely valuable and is in urgent demand for civic expansion; streets have become congested with pedestrians and vehicles; rapid transit facilities for annihilating space have been installed in most of our large cities, and the slow-going horse-drawn vehicle has been largely replaced by the high-capacity fast-moving motor truck.

In considering the solution of any given railroad problem it is therefore necessary carefully to weight the arguments for and against the location of passenger and freight terminals as near as possible to the business center. The advantages are convenience to that portion of the traveling public which can most easily complete its jorney on foot, and, in the case of freight, a slight saving in time and expense because of shortness of haul by motor truck between the freight station and the point of origin or destination. The disadvantages are the maintaining for railroad purposes in the midst of the city of vast wastes which block orderly civic expansion and contribute largely to the congestion that increasingly is becoming such a fruitful source of delay, inconvenience and expense to the public.

If, as in the case of the Grand Central Terminal at New York, the railroad approaches and station can be placed

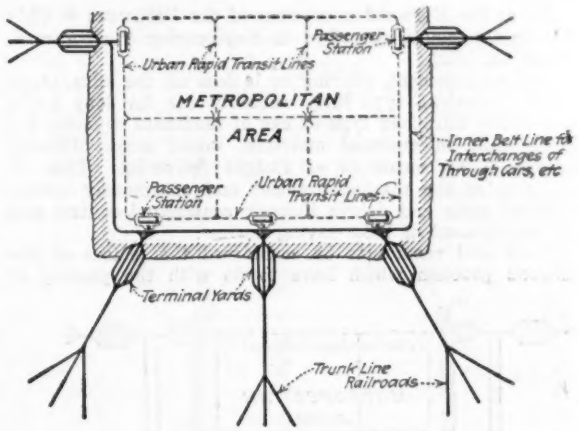


FIG. 1. PASSENGER TERMINALS IN OUTSKIRTS OF METROPOLITAN AREA CONNECTED BY BELT LINE

beneath the surface so that streets may be carried overhead without interference with the city's normal development, and if it is practicable to move trains by electricity so as to do away with nuisances incident to the use of steam locomotives and thereby permit the utilization of valuable "aerial rights" for revenue producing purposes, the better solution may be the placing of the terminal as near as possible to the business center. If, however, the underground treatment is impracticable and if the number of railroad lines and the shape of the city are such as to make undesirable this manner of solution, the course to pursue would be the banishment of the passenger terminals from the heart of the city to points sufficiently removed therefrom to afford ample space at moderate cost for the stations and yards, with contiguous parks, all planned in such manner as not unduly to interfere with future city growth.

An arrangement whereby two or more passenger terminals thus located at points comparatively remote from the business center may be inter-connected and also placed in close touch with all parts of the city by means of urban rapid transit facilities, is illustrated in the accompanying sketch (Fig. 1).

In the case of local freight terminals the advantages of having them well removed from the business center would seem far to outweigh the small advantage of a shortened haul for the motor truck. The larger portion of the expense of freight distribution lies in delays to trucks awaiting opportunities for loading and unloading at the terminals, due to restricted facilities and congested surroundings. This situation is constantly becoming worse, and is contributing in a large degree to the high cost of living in great cities. Instead of continuing the journey of the railroad car as close as possible to the business center, with the attendant high cost of property and of operation, coupled with congestion and general inefficiency, for the sole purpose of shortening the haul by motor truck, it would be better to shorten the railroad haul somewhat, lengthen the haul of the motor truck, and place the points of interchange where cheap lands abound.

In communities where the streets are broad and not overcrowded, it would be possible to continue freight distribution by means of motor trucks, but where surface congestion makes this course undesirable small car freight subways, as illustrated in the accompanying sketch (Fig. 2) should be created, in which the freight would be moved by electrically operated multiple unit trains of cars having a capacity of, say, ten tons, from the trans-shipping points on the various railroad lines, through "gridiron" sorting yards, and thence beneath the city streets to a multiplicity of points throughout the city where mechanical devices would transfer the removable car bodies from the subway vehicles to the chassis of motor trucks for short-radius surface distribution, in a manner similar to that now in

vogue at the Norwood substation of the Baltimore & Ohio R.R. in Cincinnati, described in *Engineering News-Record*, March 11, 1920.

This arrangement, offering as it does all the advantages of the American type large capacity car for long hauls and of the European type of car of moderate capacity for short hauls in cramped quarters, would mean diffusion instead of concentration of freight deliveries. Thus, it would solve the market problem and enormously reduce terminal costs and delays through centralized control and the employment of labor-saving devices.

There still remain to be considered the phases of the railroad problem which have to do with the placing of

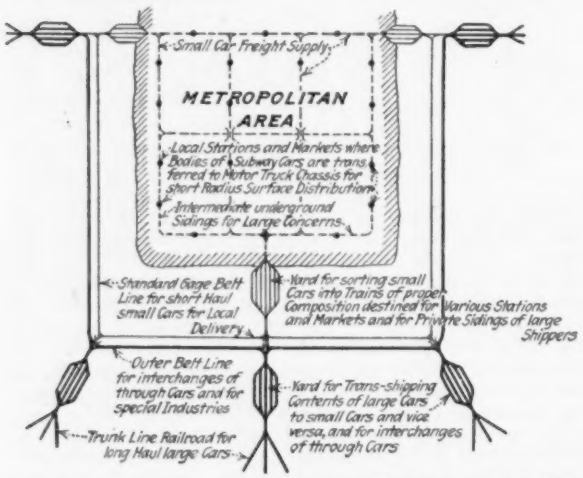

Small Car Freight Supply
METROPOLITAN AREA
Local Stations and Markets where Bodies of Subway Cars are transferred to Motor Truck Chassis for short Radius Surface Distribution
Intermediate underground Sidings for Large Concerns
Standard Gage Belt Line for short Haul small Cars for Local Delivery
Yard for sorting small Cars into Trains of proper Composition destined for Various Stations and Markets and for Private Sidings of large Shippers
Outer Belt Line for interchanges of through Cars and for special Industries
Yard for Trans-shipping Contents of large Cars to small Cars and vice versa, and for interchanges of through Cars
Trunk Line Railroad for long Haul large Cars

FIG. 2. FREIGHT TERMINALS OUTSIDE OF METROPOLITAN AREA CONNECTED BY OUTER AND INNER BELT LINES

cars on the side tracks of private industries and waterfront facilities at or near the business center; and also means of interchange between carriers for the kind of traffic that is destined for points beyond.

These needs as a rule are best met by means of belt lines, an inner one for local interchange and an outer one for the bulk of the traffic that should be excluded from the congested regions of the city. The majority of the large cities of the country are already served with inner belt lines, and many of them also with outer ones. Both are highly desirable, not only from the standpoint of interchange of passenger and freight equipment, but also for the proper development of large industrial enterprises and for the unrestricted and prompt movement of military trains in time of war. The latter need was strongly proved at Paris during the World War when it became necessary to construct missing links in the outer belt line so that troop and supply trains from different directions could be thrown to the aid of the Allied armies in stemming the advance of the enemy. An example of the evil effects that flow from the lack of adequate inner belt lines and of a comprehensive outer belt line is that of Greater New York, where the absence of these facilities is a growing menace to its commercial supremacy and to its safety in time of war. In fact, the experiences of the World War demonstrated that the latter defect bore heavily, not alone on the local community, but on the nation at large, through gross delays and confusion in the embarkation of troops and supplies.

Summarizing, the railroad problem in its relation to city planning should be treated in the light of the situation as it exists in each community, due weight being given to the following considerations:

Passenger and freight terminals for serving the community should be so located, in liaison with suitable lines of urban distribution, that the business and residential sections will be given ample opportunity for healthy expansion, that congestion will be avoided on the city streets; that full opportunity will be given for the aesthetic development of the community, and that delays and costs to the public will be reduced to the minimum.

Inner belt lines should be provided for the convenient placing of cars on private sidings of industries located where labor is readily accessible, and on tracks serving the local waterfront.

Outer belt lines should be created for the speedy and economical interchange of through freight and for access to water terminals lying outside of the city proper.

It should be added that of course grade crossings, in the interest of both safety and economy, should be avoided to the fullest extent.

Large Highway Bridge Wrecked by Pressure of Cake Ice

Brattleboro Steel Span of 330 Ft. Pushed Off Supports in Flood—Low Clearance and Effect of Power Dam Involved

BY GEORGE F. ECKHARD
Professor of Structural Engineering, University of Vermont

HEAVY damage, involving many hundreds of thousands of dollars' loss and the destruction of a 330-ft. steel highway bridge span at Brattleboro, Vt., was caused last month by high water and ice along the Connecticut River. Along the West River, a small tributary of the Connecticut, five bridges of 60-ft. or shorter span were washed away. The damage was notably severe near Brattleboro, Vt., where one life was lost and much public and private property was destroyed. Impact and pressure of floating ice was responsible for the failure of the 330-ft. bridge. The circumstances of this accident draw attention to the relation between underclearance and safety against ice, to the strength of lateral systems and to anchor-bolt practice.

The high-water conditions existing at the time of the failure of the bridge are believed by many persons to have been aggravated by artificial obstruction to the normal stream flow of the river. At Brattleboro the Connecticut River is divided into two channels by an island; a highway from Vermont to New Hampshire which crosses there is carried over the west channel by a steel span and over the east channel by a timber bridge. About three-fourths of a mile below the city, the Boston & Maine line through Brattleboro from the north crosses the river into New Hampshire, while the Central R.R. of Vermont continues south along the west bank. Six miles below, at Vernon, Vt., the Connecticut River Power Co. has a power dam, whose influence on the water level extends beyond Brattleboro.

There is a long history of failure and rebuilding of highway bridges at the site of the one just destroyed. The earliest bridge, a timber structure built in 1804, was carried away by flood in 1820. In 1824, in 1825, and again in 1843, the span over the east channel was destroyed by high water. In 1857 the two spans then carrying the highway over the west channel were swept away. In 1862 and in 1869 the bridges over both channels were lost in the "big floods" of those years.

The recently destroyed steel span was erected over the west channel in 1903. Its length was 330 ft. between faces of abutments; the deck accommodated a 26-ft. roadway and a 6-ft. sidewalk on the downstream side. The floor construction was plank on stringers. The loss of former bridges at the same site had demonstrated the serious consequences of failure to provide sufficient clearance above high water. Therefore

the new structure was built with its lower chord 5 or 6 ft. higher than that of previous bridges, and it was believed at that time that the clearance was ample to insure the safety of the bridge. In 1909 the Connecticut River Power Co. built its dam at Vernon. This dam, 32 ft. high, created a basin 16 miles long. The Boston & Maine bridge was built in 1912; it is a structure of seven spans, flanked on either bank by an approach fill, and was not injured by the flood.

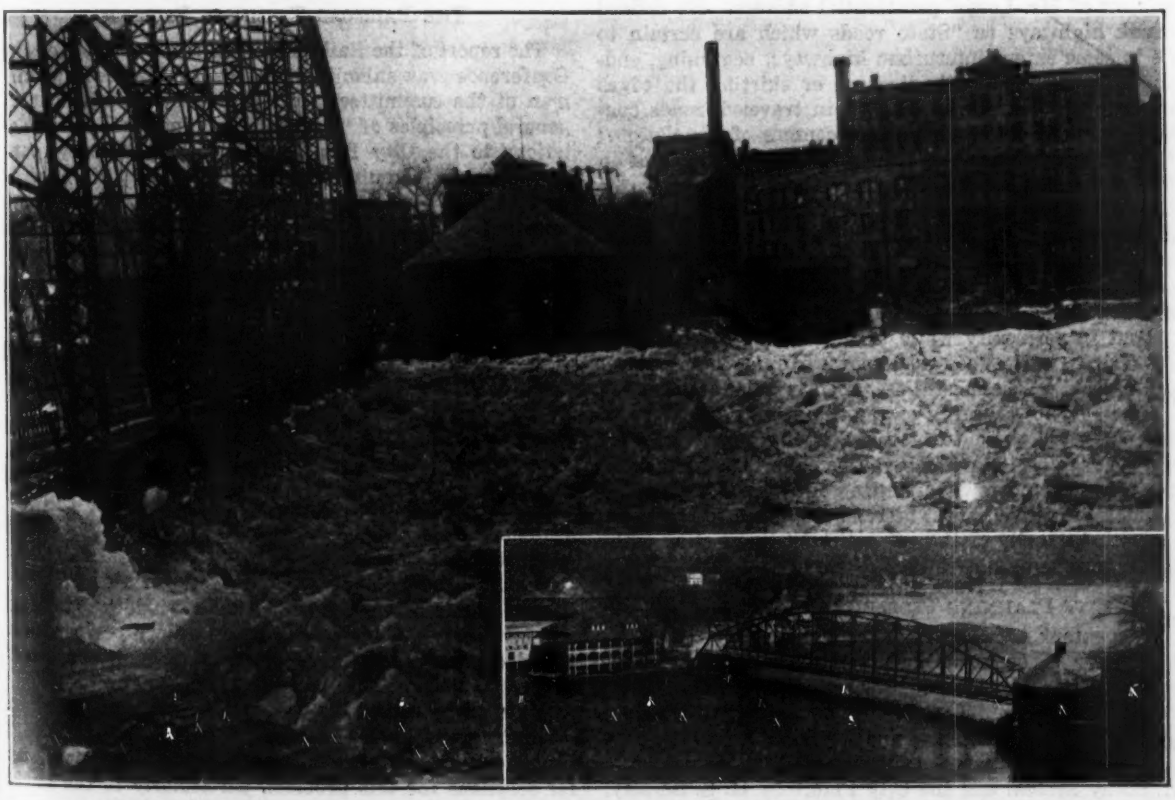
During the past winter ice formed from 1 to 3 ft. thick in the Connecticut. With the coming of mild weather, melting snow swelled the stream to flood proportions, and on Sunday, March 28, the water was only a little below the lower chord of the Brattleboro bridge. The field ice above the dam and to a point about a mile below the railroad bridge held firm, as did the ice in the east channel opposite Brattleboro. In the west channel, however, immense masses of floating ice gathered above the highway bridge and were carried along by the current, forming jams both below the railroad bridge and between the two bridges.

About 5 p.m. of March 28, the water level at the highway bridge was rising rapidly, and finally blocks of ice began pounding against the lower chord and floor system. As the hammering action and pressure of ice increased, a distinct distortion of the floor system was noted, which increased until the horizontal deflection of the lower lateral system became at least 2 ft. Since this deflection is beyond the limit of elastic deformation, it is likely that certain members of the lower lateral system gave way or tore from their fastenings. Shortly after the failure of the laterals the whole span was shoved off its bearings by the ice pressure and fell into the river, 40 ft. deep. The ultimate failure came after but did not result from the failure of the lower lateral system. Observers agree that there was no collapse nor buckling of the truss as a whole, but that it was shoved downstream as a unit and remained in nearly upright position until practically free of the abutments before finally overturning in its fall. No anchor bolts were used at the bridge seats, and in consequence no damage was done to the masonry abutments.

The loss of the highway bridge was due to no structural defect of either the steel truss or its foundations, but must be attributed wholly to inadequate clearance between the bridge and highwater elevation. The weight of steel in the bridge was about 270 tons. Had the lateral system been designed of sufficient strength and rigidity to resist the ice pressure, it is doubtful whether a correspondingly strong anchorage could have been provided.

The peak of high-water flow was reached on March 28, being 60,000 sec.ft. at the Vernon dam. In former years 80,000 to 90,000 sec.cft. has been passed with safety. The depth of water over the dam crest at the time of the failure was 8.5 ft., which is but 1½ ft. above the top of the flashboards. The rapid breaking up and release of the ice over a distance of several miles above the bridge, and the ice jams formed just below, resulted in a piling up of the ice in the constricted channel at the bridge, which produced sufficient pressure to move it from its foundations.

During the critical period of ice flow and high water, the power company alternately opened and closed the gates at the dam, hoping thereby to start the ice above



BRATTLEBORO BRIDGE AT ORDINARY STAGE AND IN 1915 FLOOD; WRECKED BY HEAVY ICE RUN

the dam. Later dynamite was also used in the attempt to break up the ice, but neither method was effective.

Immediately after the destruction of the steel span the selectmen of the towns of Brattleboro, Vt., and Hindsdale, N. H., delivered to the Connecticut River Power Co., owner of the dam, a demand that it make good the loss of the bridge as well as the damage to certain roads by high water. The power company promptly declined to accede to these demands and refused to admit any liability in the matter. Whether or not either the power company or the railroad is in any measure responsible for the conditions which caused the loss of the highway bridge can be determined only by an exhaustive engineering investigation of all the contributing factors.

City Planning Conference

A RAPID fire review of city planning progress in a dozen American cities, detailed reports on the local features of city planning problems and prospects in Cincinnati, a group of papers on railroad terminals in relation to city planning, zoning and regional planning were the main topics considered at the Twelfth National Conference on City Planning held in Cincinnati April 19-22.

Both the City Planning Conference and the City Planning Institute re-elected Nelson P. Lewis, chief engineer of the Board of Estimate and Apportionment, New York City, as president and Flavel Shurtleff, Boston, Mass., as secretary.

President Lewis' Address

"Trunk Highways and City Thoroughfares" was the subject of Mr. Lewis' presidential address. He defined trunk highways as "State roads which are certain to be to some extent interurban highways, beginning, ending in, passing directly through or skirting the edges of populous districts or any 'main traveled' roads connecting more or less important centers of population." City thoroughfares were defined as "traffic arteries of an urban district, more particularly those leading into or out of the town or connecting its residential, commercial, administrative, or industrial centers." Little consideration, Mr. Lewis stated, has ever been given to the co-ordination of trunk highways and city thoroughfares, a fact that can be appreciated by all who have floundered "about in perplexity while trying to find the best exit from a city to the good road known to exist in an adjoining district or the most direct road to another town."

To illustrate this lack of co-ordination between rural and city through routes, Mr. Lewis outlined an imaginary journey of 150 miles by automobile through a number of cities and towns, pointing out how readily many obstacles to travel might be removed, often to the great benefit of the city or the rural district in question without regard to considerations of through traffic.

City Planning Problems in Cincinnati

The extent to which topography governs city planning, even through the long period that proceeds conscious systematic planning, was brought out in papers on "Cincinnati's Rapid Transit System and the City Plan," by Frank L. Raschig, principal assistant engineer, Cincinnati Rapid Transit Commission, and on "Cincinnati's Highway System and the City Plan," by H. S. Shipley, principal assistant engineer, in charge of highways, City Engineer's office, Cincinnati. Mr. Raschig outlined the rapid transit system under construction for Cincinnati. He closed with a paragraph of general application to the city transit problem, as follows:

"With rapid transit, the whole pulse and life blood of the city will be quickened; social intercourse will be easier, for distances will be partially annihilated. The working man can live in the suburbs and work in the city and will not be exhausted by a long ride; the city will grow and spread out and the whole tendency will be toward a city more convenient and useful to everybody."

Mr. Shipley stated that Cincinnati was laid out in 1788 by Israel Ludlow on a plan modeled after that of the city of Philadelphia, with streets 66 ft. wide, at right angles to each other, on two terraces or plateaus, one of which was the wide flood plain adjoining the river and the other a somewhat higher level. These two plateaus had an area of about 4 sq.mi. as compared with the present 70 sq.mi. now within the city limits. This area soon became congested and since then the city has expanded, following the valleys of streams tributary to the Ohio. In this way a fairly good system of radial thoroughfares came into existence piecemeal, along the lines of least resistance. These can and should be improved to meet modern ideas of city planing. There is even more need for circumferential thoroughfares.

In concluding his paper, Mr. Shipley suggested that the only way of carrying out the necessary improvements to the street plan of Cincinnati, in view of the financial condition of the city, seems to be "the adoption of a benefit assessment plan, by which the districts receiving the direct benefits of improvements would pay a considerable part of their cost."

The Railroad Terminal Problem

The report of the Railroad Terminal Committee of the Conference was submitted by Nelson P. Lewis, chairman of the committee, accompanied by a statement of general principles of "Railroad Terminals and their Relations to the City Plan" by Charles H. Cheney, consultant in city planning, San Francisco, and J. P. Newell, of Portland, Ore., and also by a paper on city railroad terminal planning by W. J. Wilgus, New York City. Mr. Wilgus' paper is printed in p. 901 of this issue. Messrs. Cheney and Newell urged unified control and operation of all railroad lines within the limits of the city as essential to the requirements of modern business and public convenience, as well as economy in capital outlay and operating expenses. With unified control, municipal ownership of intra-city lines is probably not necessary. Industrial districts or zones should be planned with relation to railroad facilities. There should be co-ordination of water and railway transportation facilities and the relation of the steam and street railway systems should also be co-ordinated. The authors also suggested full co-operation between cities and railroads "in planting and improving the appearance of the borders of rights of way, yards, bridges, viaducts, stations and terminals within the city limits. Such co-operation would do away with much of the damage to adjacent property values and rentals due to railway property."

A paper scheduled on the program as "The Urban Auto Problem," by E. P. Goodrich, consulting engineer, New York City, contained not only various suggestions for solutions for this problem, particularly in the business districts, but also a lengthy historical review of good regulation of traffic on city streets.

Embankment and Concrete Work for Large Oil Reservoirs

Great Care in Handling Material Secures Smooth Hard Surfaces—Fills Are Compacted 15 Per Cent—No Joints in Concrete Paving

IN THE yards at El Segundo, Cal., where the pipe lines of the Standard Oil Co. terminate, there are now five oil storage reservoirs excavated in natural depressions and lined with concrete. The first three were laid out for a capacity of 500,000 bbl. and the two added later have a capacity of 1,000,000 bbl. each. The first four were circular and the fifth, which has just been completed, is oval in plan. The latter has a total of 326,000 sq.ft. of paved area, as against 310,000 sq.ft. in the circular reservoir. The circular reservoirs are about 500 ft. in diameter.

The soil conditions are well adapted to construction of this sort; it is possible to work the material in such way that extremely solid embankments are secured. The earth is compacted so firmly that, according to the contractors, "a spike is driven in it with a hand axe only with difficulty and it is impossible to drive stakes in the usual way." In a basin carefully finished to exact grade with such a firm surface as this it is only necessary to place a thin sheet of concrete for it serves the sole purpose of making the basin oil tight. Despite the thin paving laid without expansion joints, no cracking or leakage has been reported. The slight variation of temperature is obviously a favorable factor.

The knoll on which the reservoirs are located is only a few hundred feet from the ocean beach. The soil is a sandy loam with occasional banks of clean drifted sand. The desired finish cannot be secured with sand unless it contains a certain amount of clay or loam. Sometimes soils with little or no sand content are added to a sandy spot to improve the binding qualities, for as much as 30,000 cu.yd. of sand has been excavated in one cut and wasted because it could not be used to advantage. This did not upset calculations, however. It has been possible to determine so closely the nature and quantity of materials to be moved that cut and fill are made to balance within 500 cu.yd. on a 50,000-cu.yd. job.

This is the more remarkable because the excavated material is compacted into 15 per cent less space than it originally occupied and exactly this much shrinkage is figured when balancing cut and fill. On the sides the excavation is carried 6 ft. back of the slope on which paving is to be laid so that a very compact fill of this width can be made there. In other words, material is excavated in order that it may be put back and compacted into 15 per cent less space than it occupied before. A large factor in the contractors' success is in laying out a program for handling this material such that there will be the shortest average haul and a minimum of interference between teams. Endeavor is made to keep the teams moving over a figure-eight route.

The established custom is to begin the excavation by making a narrow cut to final depth around the outer edge, leaving only four inclines at quarter points on the circumference over which teams have access to the center. The four quadrants, called "swings" are worked as units, usually two at a time. By keeping two swings under way simultaneously the scrapers can put in a 6-in. layer of material and then move over to the other swing while a "Petrolithic" roller compacts the layer just placed.

Nine scrapers is about the economical limit to work on a swing at one time without interference. Ordinarily such a crew will place the material in layers at the rate of 35 cu.yd. per hour. Recent contracts have therefore specified that the Petrolithic roller, when kept moving constantly, shall not be permitted to finish compacting material at a rate faster than 35 cu.yd. per hour. This affords a convenient balance of one roller for each nine-team scraper crew. Only wheel scrapers are permitted and their routes of travel are arranged so that movement of material from one point to another is always via the strip being compacted in one of the swings.

Before any excavation is begun a road grader cleans off all earth down to the grass roots and this material is wasted. Plows then loosen the material for the scrapers layer by layer until the subgrade is reached. The floor is plowed to a depth of about 1 ft. below fin-

LAYING PAVEMENT ON FLOOR OF THE MILLION-BARREL OIL STORAGE RESERVOIR AT EL SEGUNDO

ished grade and after a road grader has leveled it off to as uniform a grade as possible, a 5-ton steam roller goes over it. After this a 20-ft. plank with a team on each end, the drivers standing on the plank, is dragged across the floor until the desired uniformity is secured, and, finally, the road roller goes over it once more.

The secret of success in all this endeavor to get

CONCRETE FINISHING CREW SCREEDING SLOPES

compact material on slopes and floor is the way in which water is applied. In order to get a uniform distribution of water for binding purposes, the material is all well sprinkled before it is excavated. This increases the weight of material to be handled, of course, but permits of larger scraper loads because the material clings together better. Sprinkling is continued judiciously during rolling and dragging. Inspectors have strict instructions on this point and if an excess of water causing a sogginess occurs the section affected is removed and refilled. The floor has a slight slope toward a depression near one side into which inlet and outlet pipes are led through the embankment. This is called the swing pit.

In the 6-ft. width of fill compacted on the embankments (which are made on a 2 to 1 slope) an excess of about 14 in. in width is allowed in placing the material. This makes it unnecessary for the roller to work so close to the edge as to cause sloughing. When the embankment has reached full height this 14-in. excess is trimmed off and finished to the prescribed surface by hand. In this process screeds are first set in the slope, 12 ft. apart, running up and down the slope, and grades for top and bottom are given by transit. Thus when the slope has been trimmed so the screed board can be worked from top to bottom on the screeds, much as a template works on header boards, the surface is as true to grade as the 12-ft. screed-board can gage it. Because of the hardness of the compacted material, this trimming has to be done with a heavy short-handled hoe or a mattock which literally cuts away the surface.

To reduce the amount of hand work required, as material accumulates below the screed board, a buck scraper is used to drag it down to the reservoir floor where it can be removed by wheel scrapers. The four runways are cleared to slope one at a time by hand, the material trimmed down from the last one being piled on the floor for removal with that taken from roof post footings which are not dug until after the floor is brought to final grade. The footing excavation requires a good deal of hand work, as much as 136 cu.yd. being taken from post footings in the larger reservoirs. An excavation 4 ft. wide and 4 in. deep in the floor around the entire circumference is also made by pick and shovel methods to provide a footing for the slope paving.

The concrete mixing plant containing two mixers is set on the inner edge of the embankment top under the boom of a derrick that delivers sand and crushed rock from gondola cars direct to bunkers. The mixers are not moved from this point for the entire job which, on a 1,000,000-bbl. reservoir, requires the paving of 6½ acres. Except for the amount of water, the same mix is used for slopes and floor, the proportions being 1:2:4, the rock consisting of ¾-in. and 1-in. sizes in equal proportions. The pavement is 4 in. thick in the floor and on the slopes ranges from 3½ in. at the bottom to 2½ in. at the top. The very accurate finish on the embankment and the careful operation of screed boards makes it possible to work very close to the prescribed thickness. For the floor, concrete from the mixer spout runs down the slope in a chute which delivers to buggies on the floor. For the slope the mixer spout delivers to cars on a track entirely encircling the reservoir on top of the embankment. They are taken by hand to the point where the slope is being paved. The top of the embankment is not paved.

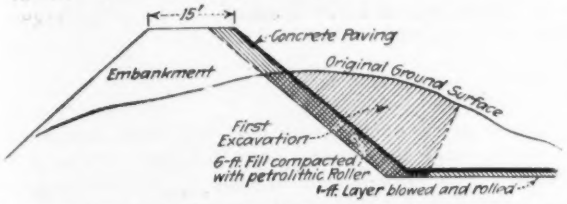
The reinforcing consists of 6 x 6-in. mesh of No. 6 wire. On the slopes it is laid circumferentially. Reinforcing is laid over the entire area at once, lapped one mesh at joints and tied, and as the concrete is being poured, it is pulled up to position in the paving by means of a hook. On the floor, concreting begins at the swing pit and the entire bottom is poured without joints. Header boards are placed 12 ft. apart and the 12-ft. strips are poured alternately and given a trowel finish. Working a crew of ten men on buggies (for the average floor delivery) and eight men spreading and finishing on the floor, together with two men on Koppel cars serving the slope and five men receiving and finishing on the slope, it has been possible to average more than 120 cu.yd. of concrete per eight hours. The yardage placed on the slope was only a small part of the total. On exceptionally good days 180 cu.yd. were placed all told, and an average of 160 cu.yd. was maintained on one occasion for five consecutive days.

Entirely separate crews are worked on the slopes because a stiffer mix and different methods are required here to handle the concrete to advantage. Screeds similar to those used in trimming are first placed 12 ft. apart on top of the reinforcing and hoes or square nosed shovels are used for spreading the concrete. This crew works from the top down and is followed by two screed board men who work from the bottom up. If concrete accumulates above the screed board the shovelmen from a strip nearby help by shoveling the surplus further up the slope. After a little practice the shovelmen gage their work very accurately and seldom have to come back to help the screed board crew. As on the floor, the slope strips are placed alternately.

The mix is somewhat too stiff for the screed board

to leave a very smooth finish, so 1:2 grout is dumped on the screeded slopes and spread with a trowel. Chutes are sometimes used on the slopes.

The reservoirs are covered with a prepared asbestos roofing supported on a wood frame. The roof sup-



CROSS-SECTION SHOWING ORIGINAL GROUND SURFACE

ports are single 6 x 6 posts about 25 ft. long. After the roof is on, the entire concrete paving is given a brush coat of sand and cement.

Contract prices for the construction of these reservoirs in 1919, when common labor cost $4 per eight hours, were as follows:

For excavating material and delivering it to fill or spoil bank, 75 cents per cu.yd. For compacting fill, 15 cents per cu.yd. Hand trimming side slopes, 3½ cents per sq.ft. Grading floor, ½-cent per sq.ft. Digging footings in finished floor surface and removing material from reservoir, $5 per cu.yd. Reinforced concrete paving, $16 per cu.yd. (It is notable that on the entire 6½ acres only 4,000 cu.yd. were required.) The cost of carpenter work on the roof, which contains about 806,000 board ft. on the larger reservoir, is estimated at about $14 per thousand ft. of lumber, although this work was not let by contract.

Bent Brothers of Los Angeles have carried out the general contracts on all five of these reservoirs.

Paper-Wrapped Garbage Makes Trouble

ATTEMPTS to dispose of paper-wrapped garbage at Minneapolis, Minn., by feeding to hogs have given so much trouble that the contractor has been forced to change the site of his hog-feeding ranch. For years past the garbage of Minneapolis has been burned. The local health department had taken great pains to educate the people to wrap their garbage in paper before putting it in the collection can, this having been urged by the department on the grounds of sanitation. When the contract was let for feeding the garbage to hogs it was considered undesirable to tell the people to stop wrapping the garbage in paper and it was supposed that the garbage could be handled at the hog-feeding ranch without serious trouble even if it were wrapped in paper. The feeding company has estimated that half the weight of the material it receives is paper. It has found it difficult to dispose of the paper by any means attempted. When the paper has been burned in the open air it has created a smoke that has settled over large areas of the surrounding country and given rise to many complaints from the inhabitants. Suits brought against the feeding company on account of the nuisance incident to its plant have led the company to agree to discontinue the feeding of garbage at this place on May 1 of this year. The contract will still have nine or ten months to run and the company is looking for a new site. It is reported that the company will not attempt to secure a renewal of the contract at its expiration. The contract is held by the Reservoir Heights Stock Ranch Co. which pays $1.26 a ton for the city's garbage.

Salary Increases of Engineers in Iowa

AN investigation of salaries paid engineers in Iowa in 1915 and 1919 in State, county and city service was made recently and reported to the Iowa Engineering Society by the committee on professional practices. The conclusions were to the effect that the salaries in 1915 were too low, that they had not been increased in proportion to the increased cost of living and that they should be increased to at least 50 per cent above *what they should have been in 1915.* (Italics editor's.) Letters were sent to 170 engineers with the following results:

Teaching Staffs	Average Salary 1915	Average Salary 1919	Percentage of Increase
Deans and directors	$4,900	$5,150	5 1
14 Professors	2,900	3,726	28 44
18 Associate professors	1,955	2,546	30 23
14 Assistant professors	1,585	2,025	27 76
23 Instructors	1,194	1,628	37 20
Highway Commission			
Chief engineer	$3,600	$5,000	38 89
Road designers	1,500	2,100	40 00
Road draftsmen	1,380	1,600	16 00
Resident engineer	1,600	2,100	21 25
Bridge engineer—head of department	2,300	3,600	56 52
Assistant bridge engineer—preparation of plans	$2,200	$3,200	45 45
Bridge designer	1,600	2,400	50 00
Bridge draftsman	1,380	1,700	23 19
Drainage engineer	1,800	2,500	38 89
District engineer	2,000	3,000	50 00

The position of road engineer at $2,700 in 1915 was discontinued in 1919, and the positions of engineer of road management, engineer of road maintenance, engineer of road design and engineer of road construction were created at $3,375.

County Engineers	Average Salary 1915	Average Salary 1919	Percentage of Increase
72 County engineers	$1,633	$2,165	32 59
48 Assistant county engineers	1,156	1,610	39 36
9 Second assistant county engineers	965	1,520	57 51
7 Drainage engineers	1,747	2,322	32 96
2 Assistant drainage engineers	1,380	1,716	24 35
32 Helpers, rodmen and chainmen	757	1,142	50 77
Municipal Engineers in Cities of First Class			
11 City engineers	$1,845	$2,058	11 52
9 Assistant city engineers	1,370	1,706	24 51
6 Second assistant city engineers	1,180	1,561	32 33
5 Draftsmen and office clerks	1,099	1,378	25 33
11 Rodmen	791	1,066	34 71
Municipal Engineers in Cities of Second Class			
8 City engineers	$1,485	$1,890	27 33
5 Assistant engineers	1,174	1,801	53 42
6 Rodmen	783	1,151	47 00

The high percentage of increase for assistant city engineers is due to one city reporting a man hired by the day and the salary computed yearly on that basis.

Brittleness in Sheet Lead

Cases of brittleness in sheet lead have recently been studied by the Bureau of Standards. Effects of corrosion sometimes transform sheet lead into a brittle, granular condition, which has often been supposed to be chargeable to allotropic transformation resulting in something analogous to the well-known "gray tin." Metallographic examination of such brittle lead by Henry S. Rawdon now has shown that the individual grains of the brittle lead are the same as those of ordinary lead, but the inter-crystalline cohesion of the grains is abnormally low. Corroding agents attack the impurities in the metal, which lodge chiefly between the grains, and possibly also attack the presumptive "inter-crystalline cement." Specimens of exceptionally pure lead (99.993 per cent) immersed for 24 days in a neutral solution of lead acetate became appreciably embrittled by the formation of minute intercrystailine fissures. No evidence was found that there is an allotropic form of lead or anything similar to "gray tin."

First Year's Operation of Washington's Municipal Garbage Reduction Works

Contractor's Plant Purchased at Low Figure—Book Profit, $26,600, General Overhead Excluded—53,258 Tons of Garbage Yielded 3,380 Tons of Tankage and 1,027 Tons of Grease Valued Together at $227,000

By F. C. Bamman
Consulting Engineer, Washington, D. C.

CONSIDERED purely as a commercial enterprise, Washington's garbage reduction works would pay but little income tax at the close of its first year under municipal control. Revenues exceeded expenses, it is true, and with most methods of municipal accounting a small profit would be shown. But when, to the items the municipality regards as expenses, are added those other unavoidable items a private company *knows* to be expenses, at least the major part of the "profit" moves to the wrong side of the ledger.

GENERAL VIEW OF WASHINGTON GARBAGE WORKS

The relatively poor showing of the Washington plant is not necessarily a reflection of the ability of the municipal officials charged with its operation. The plant had admittedly reached its economic life some years ago. The private company owning it to July 1, 1918, naturally permitted it to run down during the closing months of the contract, and the spirit of labor unrest, high labor costs, the usual legislative "red tape" limitations, the big decrease in by-product prices, etc., all conspired to bring about a condition detrimental to efficient management. The most important factors would have likewise existed to curtail profits had private operation con-

Prior to July 1, 1918, both collection and disposal of Washington's garbage was done under a single contract. Collections were made by horse-drawn vehicles carrying a metal tankbody of about 2½ cu.yd. capacity. The filled tanks were removed from the running gear at a transfer station within the city limits and placed on rack cars for rail transportation to the disposal plant about 30 miles down the Potomac River, in Virginia.

After repeated advertisements for bids to carry on the work by contract, the entire plant and equipment of the contractor, the Washington Fertilizer Co., was purchased by the District of Columbia. This purchase included the horses, vehicles, tank cars, equipment and lease of transfer station, etc., as well as the reduction works. The price paid was $85,000, said to be less than an official survey gave as the junk or forced sale value of the various items turned over.

The District, upon taking over the work, continued collection along the general lines laid down by the contractor. The same system of tank wagons was generally continued, but motorized equipment was placed in service for making collections from hotels, restaurants and other large garbage production centers in the downtown districts.

The transfer station was retained, both because of its excellent location from a haul standpoint and to avoid the unenviable difficulty with adjacent residents and property holders which could be expected with the introduction of such a station in a new location. While the general plan of operation was retained, the entire transfer station property was overhauled and improved. Sanitary conditions in and about the station are certainly far better than when the work was done by contract.

The reduction works turned over by the company was built about 20 years ago and has been used continuously for disposal of Washington's garbage. The process employed is cooking by steam in sealed digestors, pressing by internal steam pressure and then in hydraulic rack presses; the drying of the pressed cake in a direct heat dryer and the leading of the liquids extracted by pressing through settling and grease skimming basins. Extraction of grease by application of a solvent is not attempted nor is any equipment included to recover the solids contained in the liquids resulting from the pressing process. The plant location is isolated and condensation of vapors has not been necessary. Digestors are vented directly into the atmosphere and dryer fumes undergo no treatment to relieve them of odors.

The general appearance of the works is shown by the accompanying view. It leaves much to be desired from the standpoint of sightliness, while its wooden floors and general physical character do not admit of a high sanitary condition. The main or digestor building contains 24 Chamberlain digestors, 8 hydraulic rack presses, unloading apparatus, skimming basins, etc. The dryer house, with its single direct heat dryer, is located about 100 ft. away and the pressed cake is conveyed from the presses by a belt conveyor. The power plant, totaling 450 hp. in six boilers is between the two in a lean-to to the main building.

TABLE I. SUMMARY OF EXPENDITURES WASHINGTON GARBAGE REDUCTION PLANT, YEAR ENDED JUNE 30, 1919*

	From Annual Report of D. C. Supervisor	According to Writer's Investigation
Capital investment	$63,303.41	$73,446
Operation costs, other than labor	$118,757.05	$90,345
Labor, direct operation	85,069.51	85,844
Supervision, plant overhead, etc.	6,200.04	8,787
Total expenditures	$210,026.60	$184,976
Fixed charges		15,424
Total expenditures and fixed charges		$200,400
Revenue, grease and tankage	$230,288.97	227,009
Profit, excluding fixed charges	20,262.37	42,033
rofit, including fixed charges		26,609

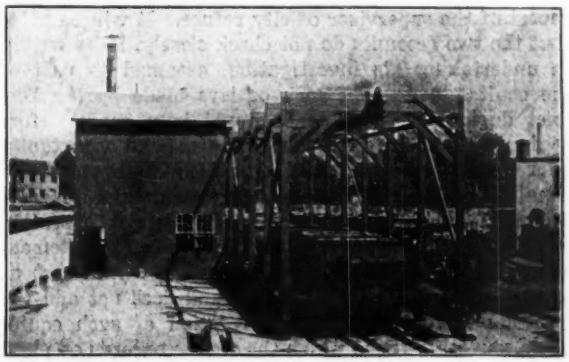
* See text for items of expense not included.

TABLE II. OPERATION ACCOUNT WASHINGTON GARBAGE REDUCTION PLANT, 1918–19*

Capital Investment:			
Purchase price, entire plant and equipment		$85,000	
Less inventory, collection equipment		35,110	
Net cost reduction plant			$49,890
Plant betterments: Miscellaneous equipment		10,617	
Small tools		1,040	
Conveyors, etc		1,400	
Lumber, etc		2,000	
Railroad siding		1,000	
Pipe lines and fittings		1,154	
Labor for installation		6,345	
Total betterments			23,556
Total investment			$73,446
Operation:			
Supplies and repair parts:			
Repair parts	$4,366		
Miscellaneous hardware	2,584		
Miscellaneous supplies	2,959		
Forage	374		
Belting, cable, etc	1,064		
Lumber, and mill work	889		
Press cloth and burlap	6,984		
Press racks	4,105		
Freight and expressage on supplies, etc	1,308		
Total supplies and repair parts		$24,633	
Coal Account:			
5,662 tons coal, including freight		28,386	
Freight, etc., on garbage:			
Freight, rack cars	$21,195		
Gondolas	4,890		
	$26,085		
Mileage rebate	498		
Net freight		25,587	
Rental of gondolas		7,137	
Repairs to rack cars		2,417	
Repairs to railroad siding		950	
Total garbage transportation		36,091	
Miscellaneous Account:			
Chemical analyses		$407	
Miscellaneous expenses		828	
		1,235	
Total direct cost other than labor			90,345
Labor costs:			
Power plant and repair shop		8,663	
Repairing press cloths		489	
Repairing press racks		743	
General repairs		341	
Unloading coal		4,143	
Handling ashes		461	
Boiler repairs		182	
Total for power plant and repairs		15,022	
Unloading and conveying raw garbage		14,213	
Cooking and pressing		31,609	
Dryer house and drying		11,873	
Grease skimming and storage		1,593	
Total for digesting, pressing and drying		45,075	
Bull gang, miscellaneous labor, etc		2,283	
Total direct labor cost		76,593	
Bonus pay, Act of Congress		9,251	
Actual labor cost			85,844
Total direct labor, supplies, and repairs			$176,189
Plant Overhead:			
Superintendent	2,500		
Assistant superintendent	2,100		
Chief engineer	1,600		
Timekeeper and clerk	1,544		
Overhead labor		7,744	
Bonus pay, Act of Congress, $120 each		480	
Rents	460		
Taxes	103		
Miscellaneous overhead		563	
Total plant and overhead			8,787
Total direct expenditures, reduction plant			$184,976
Fixed charges:			
6% interest on investment, $73,446		4,407	
Depreciation, 15% of investment		11,017	
Total fixed charges			15,424
Total: Operation and fixed charges			$200,400
Revenue:			
Sale of 2,057,584 lb. grease			185,437
Sale of 3,380 tons tankage		41,572	
			227,009
Profit			$26,609

* See text for items of expense not included.

From a contractor's viewpoint, the plant was far from a bad one. Odors incidental to the process were not seriously objected to and practically the only people affected were those connected with the plant in some capacity. The cost of operation was comparatively low,



WASHINGTON GARBAGE TRANSFER STATION

colored labor being generally used and their pre-war wage scale averaging around $1.50 per day. The Washington grease yield has always been high and, being composed only of pressed grease, it found a readier sale than that produced by both pressing and percolation, if not commanding a premium. The Washington Fertilizer Co., in fact, claimed that the advantages of producing a purely pressed grease more than offset the value of the additional grease which could be recovered upon extracting with a solvent.

From a municipal standpoint the plant is far from satisfactory and although many improvements have been made it is still regarded by district officials as only a temporary expedient at best. Changes made by the municipality include improvement in methods of unloading, installation of new digestors, relocation of railway siding, etc. Further improvements are contemplated and in progress, but these are all intended only to tide over until a permanent method of disposal is decided upon. Whether this will be another reduction plant, disposal by feeding, or some other methods of utilization, District officials will not venture an opinion.

The cost data submitted herewith do not include any items incidental to collection or loading on cars; they deal only with the reduction plant and transportation to it. The cost data are not comparable with the prior contract cost, which covered both collection and disposal, nor are they always directly comparable with published figures for other municipal plants.

Table 1 gives a summary of the writer's investigation as compared with the statement given in the annual

TABLE III. ORGANIZATION SCHEDULE, WASHINGTON GARBAGE REDUCTION PLANT

Supervisory and clerical:	
1 Superintendent	$2,500 year
1 Assistant	2,100 year
1 Timekeeper and clerk	5.65
2 Watchmen	3.41
Power-plant and repair shop:	
1 Chief engineer	$1,600 year
3 Engineers	4.61
3 Firemen	4.61
3 Laborers	3.00 to $3.41
2 Skilled laborers	3.97
1 Seamstress	2.93
Unloading section, raw garbage:	
1 Engineer	$4.61
2 Skilled laborers	3.97
2 Dumpmen	3.01
Cooking and pressing section:	
3 Cookers	4.61
9 Pressmen	4.29
20 Skilled laborers	3.97
Drying section:	
1 Foreman-fireman	$4.29
4 Skilled laborers	3.97
Grease recovery section:	
1 Greaseman	4.61
Miscellaneous section:	
1 Foreman	$4.37
1 Skilled laborer	3.97
6 Laborers	$3.01 to $3.41

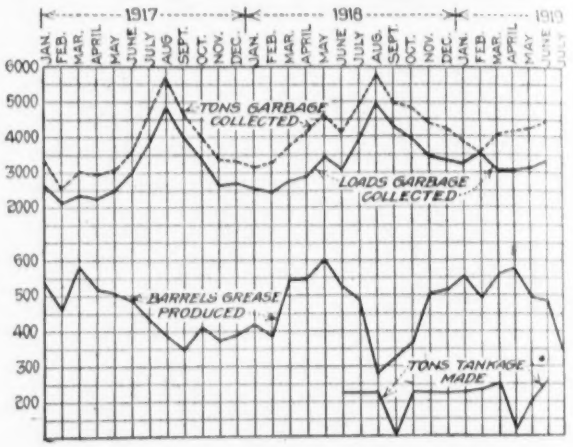
report of the supervisor of city refuse. It will be noted that the two accounts do not check closely. The writer, in undertaking his investigation, assumed as part of the capital investment such outlays made by the District during the year as it would have made before beginning to operate the plant had time and opportunity offered. Improvement and operation were conducted simultaneously, the contractor treating the garbage delivered June 30, 1918, and the District operation beginning the following day. The official statement assumes as capital investment only the initial cost of certain large items of equipment and does not add the expenses incidental to the installation of such equipment, nor other items which the writer regards as plant betterment rather than repair items.

The difference in the two statements for the item of operation other than labor is partly accounted for by the items transferred to investment, but is also caused by the official statement disregarding the inventory value of supplies and materials on hand at the expiration of the year.

The labor items, while seemingly about the same in each statement, vary approximately $10,000, but this about equals the equipment installation costs transferred in the writer's statement to investment. This $10,000 difference is due to the omission in the official statement of certain items of bonus pay. These bonus amounts were not part of the regular appropriations under which the plant operated and did not come under the control of the supervisor. They are nevertheless costs and a proper charge against the plant.

The difference in the amounts shown as revenue is largely due to the writer's investigation having been made later than the official statement, when certain shipments of by-products were figured at assumed values pending settlement. The profit indicated in the two statements varies more than 100 per cent, but this difference has already been explained. It is rather significant that the writer's investigation indicates the greater profit and that, because of the small investment for a plant of this type, the fixed charges assumed are not sufficient to equal this difference.

The profit indicated under either of the two accounts is in reality a paper rather than an actual profit. No interest on working capital has been included; insurance in any form is prohibited by law; no taxes are paid. Because of statute limitations, appropriation rulings,



GARBAGE COLLECTED, GREASE AND TANKAGE PRODUCED AT WASHINGTON, JANUARY 1, 1917, TO JUNE 30, 1919

etc., none of the general office expenses properly chargeable to operation are included. No pro rata charge has been made for the time of the supervisor, although he has unquestionably spent a considerable portion of his time on garbage disposal matters. The salaries and considerable expenses incidental to selling by-products and keeping accounts are not included. Neither are such items as postage and stationery, telephone and telegraph, the pro rata share of the purchasing department chargeable to reduction, or the similar amount chargeable because of auditors' expenses, the rental charge for office space occupied in the Municipal Building at Washington, the pro rata share of the salaries and office expense of District officials superior to the supervisor of city refuse, and so on. These items, while all but impossible to determine in this particular case, would have a considerable bearing on the operation of this plant as a purely commercial enterprise.

Table 2 gives in considerable detail the items making up Table 1. In the case of supplies, repair parts, coal, etc., the amounts given are actual purchases less material on hand at the close of the year. The fixed charges show depreciation to have been assumed at 15 per cent. This is seemingly high but the general condition of the plant, and its low initial value, make this rate desirable and necessary.

Tables 4 and 5 indicate a condition common to a number of garbage reduction plants at the beginning of the year. During the war garbage grease prices had reached unheard of heights; its value lay in the need of glycerine, of which normal garbage grease carries 10 per cent. Most grease contracts expired on Dec. 31 and, the armistice having been signed and the need for glyc-

TABLE IV. TANKAGE CONTRACTS, WASHINGTON GARBAGE REDUCTION PLANT, 1918–19*

Contract effective July-December:	
NH3@$5.62; P2O5@10c.; K2O@$1	f.o.b. plant
Total sold: 61 cars or 1,637.82 tons	$30,001.92
Contract effective January:	
NH3@$2.75; P2O5@10c.; K2O@60c.	f.o.b. plant
Total sold: 11 cars or 322.72 tons	$3,319.07
Contract effective February-March:	
NH3@$2.35; P2O5@10c.; K2O@ nothing	Less freight
Total sold: 21 cars or 631.16 tons	$3,630.94
Contract effective April-June:	
NH3@$2.25; P2O5@10c.; K2O@ nothing	Less freight
Total sold: 29 cars or 787.95 tons	$4,619.63
Total for year: 122 cars or 3,379.65 tons	$41,571.56

* Prices given are per ton of tankage for each single per cent of the respective items. Thus, with a tankage analysis showing NH_3, say 3.0, P_2O_5 at 10.0, and K_2O at 0.5 and with a contract at say $3, 10c. and 50c., respectively, the value of one ton of tankage would be

NH_3, 3×$3	$9.00
P_2O_5, 10×10c.	1.00
K_2O, 0.5×50c.	.25
Value of one ton tankage	$10.25

TABLE V. GREASE CONTRACTS, WASHINGTON GARBAGE REDUCTION PLANT, 1918–19*

Contract effective July-December:	
13½c. per lb.	f.o.b. plant
Amount sold: 2,429 bbl. or 906,690 lb. net	$121,887.88
Average weight per bbl., 373.3 lb.; moisture, 1.62%; insoluble, 0.48%; unsaponifiable, 2.23%.	
Contract effective January:	
7.03c. per lb.	f.o.b. plant
Amount sold: 416 bbl. or 156,300 lb. net	$10,881.55
Average weight per bbl., 369 lb.; moisture, 1.56%; insoluble, 0.26%; unsaponifiable, 2.19%.	
Contract effective February-March:	
5.28c. per lb.	f.o.b. plant
Amount sold: 1,209 bbl. or 452,739 lb. net	$23,706.79
Contract effective April-May:	
5.02c. per lb.	f.o.b. plant
Amount sold: 1,066 bbl. or 397,513 lb. net	$19,678.42
Contract effective June:	
6.55c. per lb.	f.o.b. plant
Amount sold: 386 bbl. or 144,342 lb. net	$9,282.80
Total for year: 5,506 bbl. or 2,057,584 lb. net	$185,437.44

* Under each contract 3% M.I.U. (moisture, impurities, unsaponifiable) was allowed

erine explosives no longer existing, the new year found a number of plants without contracts, or else under agreement to sell their product at practically the buyers' offer. In the case of the District plant, the return was cut to all but half.

Tankage contracts were affected in the same way by the release from munition purposes of nitrogen carriers all but non-existent as fertilizers during the war period. Almost no market was to be found.

The sharp decrease in the prices of by-products materially affected the success of the distrct and every other reduction plant. With income suddenly decreased there was no corresponding tendency on the part of labor costs or operation expenses. They, if anything, showed increases.

Fortunately, better prices are now prevailing. Table 4 shows the district's low tankage value to be in the April-June contract. The price now being received is NH_3, $3.85; P_2O_5, 10c.; K_2O, nothing. For grease, the April-May contract marks the low point. June is over 1½c. better and the present price is 9.77c. per pound.

The record of garbage collection (Table 6, also see diagram) is particularly interesting in that, unlike most cities, Washington's garbage production increased during the war period. This increase is easily accounted for by the increased population engaged in war activities. The record also shows that 1919 production exceeded that of 1918. This same condition can be noted of garbage production in most other cities. Once the patriotic appeal for food saving ended, high prices failed to hold down wastage. Pre-war production has not been reached and will not be until prices drop, but the downward curve of per capita production reaches a level and slowly climbs toward its old high level.

TABLE VI. TONS GARBAGE COLLECTED AT WASHINGTON
from 1915 to 1919 inclusive

Month	1915	1916	1917	1918	1919
January	3,745	3,743	3,319	3,108	3,853
February	3,283	3,427	2,574	3,291	3,557
March	3,548	3,565	3,054	3,579	4,085
April	3,829	3,835	2,935	4,149	4,151
May	3,969	4,313	3,038	4,606	4,227
June	4,002	3,927	3,592	4,135	4,419
July	5,266	5,314	4,633	4,869	....
August	6,341	5,850	5,692	5,732	....
September	5,330	4,419	4,633	4,957	....
October	4,607	3,928	4,087	4,823	....
November	3,930	3,292	3,349	4,334	....
December	3,846	3,368	3,401	4,251	....
Total	51,718	49,031	44,307	52,014	....
Total for year ending June 30	....	52,202	44,683	48,843	53,258

TABLE VII. SUMMARY, GREASE AND TANKAGE ANALYSES, WASHINGTON GARBAGE, 1918–19
(In percentages of weight of garbage)

		Grease							
		Moisture		Insoluble		Unsaponifiable		Available Fat	
Month	Number of Analyses	Monthly Average	Cumulative Average	Monthly Average	Cumulative Average	Monthly Average	Cumulative Average	Monthly Average	Cumulative Average
July	3	2.43	2.43	0.53	0.53	2.27	2.27	94.77	94.77
August	2	1.41	1.92	0.48	0.51	2.58	2.42	95.53	95.15
September	2	1.63	1.82	0.54	0.52	2.30	2.38	95.53	95.28
October	2	1.98	1.86	0.55	0.53	2.30	2.36	95.17	95.25
November	3	1.02	1.69	0.43	0.51	1.99	2.29	96.56	95.31
December	3	1.31	1.63	0.39	0.49	2.12	2.23	96.18	95.65
January	4	1.41	1.60	0.26	0.45	2.21	2.25	96.12	95.70
February	3	1.26	1.56	0.32	0.44	2.16	2.24	96.26	95.76
March	4	1.50	1.55	0.32	0.42	2.23	2.24	95.95	95.79
April	3	1.38	1.53	0.43	0.43	2.43	2.26	95.76	95.78
May	3	1.68	1.46	0.35	0.42	2.43	2.27	95.54	95.85
June	3	2.35	1.53	0.83	0.45	2.55	2.30	94.27	95.72

Yearly Average, M.I.U. (Moisture, Impurities, Unsaponifiable), 4.28 per cent.

		Tankage					
		Ammonia		Bone Phosphate		Potash	
Month	No.	Per Analysis	Cumulative Average	Per Analysis	Cumulative Average	Per Analysis	Cumulative Average
July	1	3.06	3.6	12.45	12.45	0.60	0.60
August	2	2.80	2.93	10.53	11.49	0.36	0.48
September	3	2.93	2.93	11.95	11.64	0.33	0.43
October	4	2.86	2.91	11.36	11.57	0.41	0.43
November	5	2.86	2.90	11.71	11.60	0.47	0.43
December	6	3.12	2.93	11.80	11.65	0.54	0.45
January	7	3.32	2.99	10.49	11.47	0.41	0.45
January	8	3.04	3.00	11.36	11.46	0.31	0.43
February	9	3.04	3.00	9.57	11.25	0.35	0.42
March	10	2.98	2.99	9.48	11.07	0.39	0.42
April	11	3.08	3.01	10.62	11.03	0.29	0.41
May	12	3.22	3.02	11.34	11.06	0.32	0.40
June	13	3.10	3.03	11.30	11.07	0.33	0.39

Per Capita Production High

Washington has long been noted for its high per capita garbage production. In a number of instances this high production has been cited as indicating extreme wastefulness on the part of Washington housewives. As a matter of fact, the true cause was the complete elimination of private collectors and the inclusion of the garbage produced by all of the city's large floating population while determining the per capita production on the basis of Washington's permanent population.

Since the date of beginning municipal collection and disposal, a change in the police regulations has permitted the private collection of garbage and a large amount of material formerly going to the reduction plant is being utilized by private parties. The Washington housewife is to be relieved of the stigma of wastefulness and Washington's garbage production will fall to that of other cities. The sanitary conditions of the city cannot fail to suffer from the change and it cannot be expected that the reduction plant will nearly equal the old recoveries of by-products with the lessened quantity and elimination of the higher quality material—that produced by the larger hotels, apartments, and restaurants.

The control of Washington's garbage collection and disposal system is vested by the commissioners in the supervisor of city refuse, Morris Hacker. The contractor's plant superintendent, J. G. Crane, has been retained by the district in a like capacity.

Steel Water Main Electrolysis in St. Louis Serious

EXTENSIVE electrolysis of a 36-in. steel lock bar water main laid in 1917 in St. Louis caused serious trouble at three points during the year which ended April, 1919, according to the annual report of the water commissioner, E. E. Wall. This five-mile main extends from Bissell's Point pumping station to Compton Hill reservoir. It has only four cross-connections to the distribution system, but passes under numerous street-railway tracks. A description in detail of the conditions by L. Chivvis, engineer in charge of the distribution section, follows:

During October, 1918, the first leak due to electrolysis was found at Park and Theresa. The pipe was uncovered and was found to be badly pitted. Rivet heads were partially eaten off, several holes had progressed far enough to cause leaks, and in 137 places the holes were deep enough to require welding. The protective coating of burlap and rubber cement had not prevented this action, since a large percentage of the pits were found under an apparently perfect cover. After a conference with the United Railways engineers the line was drained, and all damage repaired by the company's welding crew, using oxygen and

acetylene gas. After a series of potential readings and gradient determinations, it was decided to drain the steel pipe electrically to the 39th St. power house. This was done Dec. 16, 1918, by welding a plate to the pipe, and from this leading a 500,000 circ.-mil cable to Grand and Park, where the newly bonded Park Ave. rails can be relied upon to make the return current to 39th Street.

The element of danger in bonding this pipe to the rails lies in its very purpose. Providing an outlet of low resistance at the point of bonding affords an easy and inviting path for stray currents that are near the steel line and encourages them to travel toward and from the cast-iron system where it lies close to the steel main, and at the four points where the two systems are connected. The increase of current leaving the cast-iron main at points of near approach to the steel will increase the electrolytic damage at these points, and the very great increase of flow at the four points of actual contact is likely to cause trouble where this current has to leap over any lead joints which may have a high insulating value due to the lead not making a perfect contact with the pitch-coated pipe. The uncertainty of the location of such joints would point to an insulated pipe length at these four contact points as the proper solution, but this in its turn is open to the objection that it would increase the flow at the points above mentioned, where the cast iron is separated from the steel by a short distance. Potential gradient determinations south of Park Ave. showed a flow of 18 amp. before bonding and 155 after, the greater part of the increase probably coming through a 36-in. cast-iron outlet and a 6-in. filling connection.

During March, 1919, the second series of leaks developed at St. Louis and Garrison and one block south on Garrison. Excavation showed that at Coleman a hole had been eaten in the steel main due to its proximity to a 20-in. cast-iron water pipe which was in turn feeding the street car-rails at St. Louis. At the St. Louis Ave. crossing 187 pits of welding size were discovered and were promptly repaired as before by the United Railways Co.'s welding crew. Shortly after, a third alarm from North Market and Laflin disclosed damage of almost as great magnitude and was handled in the same manner.

In neither of the last two cases was the pipe drained to the rails. A cable was welded on at North Market St. and connected to the rails, but inasmuch as the current immediately leaped from 17 amp. to 480, its use was discontinued. A short bond was welded between the steel and cast-iron mains at Coleman to prevent a recurrence of trouble at that point and to distribute the flow.

The solution of the trouble at North Market and at St. Louis Ave. is still to be made, although the three-wire system, wherein the rails are neutral, was suggested by United Railways engineers.

Mr. Chivvis concludes that the steel pipe itself has shown that it is not an ideal material for city use where its excellent qualities as an electrical conductor subject it to damage from stray currents, although the entire absence of trouble on the 8-in. steel line to Bellefontaine Farms is an indication of its utility in outlying districts.

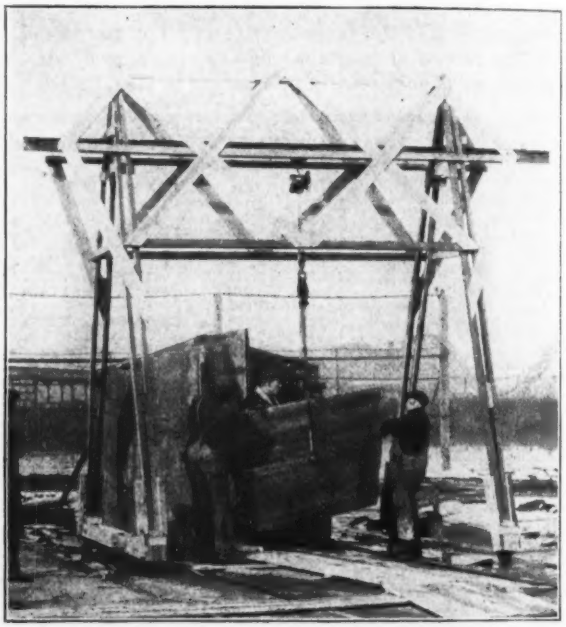
Water-Works in the Province of Quebec

Water-works in the Province of Quebec number 440, but more than half of them serve populations of 500 or less each, according to a paper by T. J. Lafreniere, chief sanitary engineer Quebec Provincial Board of Health, read before the meeting of the Engineering Institute of Canada on Jan. 28. The 192 works serving places of over 500 each supply a combined population of 1,383,700. Of this total population 86 per cent is supplied from rivers, 4 per cent from lakes, and 10 per cent from springs or wells. Regardless of size and number of works, a population of 860,000 is supplied with filtered water and 170,000 with chlorinated water.

Thin Bath-House Concrete Slabs Cast and Handled on Edge

RECONSTRUCTION of the Amusement Park at Brighton Beach, New York, destroyed by fire last year, has involved the use of concrete construction as a substitute for the old type of wooden bath-houses. The new bathing pavilion, with a capacity of 11,000 bathers, includes 4,790 small bathhouses (3 ft. 6 in. x 4 ft. in plan- and 209 large bath houses (6 x 7 ft. in plan) each of the latter being equipped with 10 lockers. For the large bath-houses the walls are of metal lath and cement stucco construction, but in the case of the smaller shelters precast slabs of cinder concrete, only 1¾ in. thick and unreinforced, are employed. Special care had to be exercised in casting and placing these thin slabs.

Forms for the slabs are built of selected 6-in. roofers with 2 x 2-in. battens forming the ends of the slabs. The slab is cast on one of its long edges, the bottom



TRAVELER ERECTING PRECAST BATH-HOUSE SLABS

being a 2 x 2-in. piece secured by bolts cast in the concrete, which is the permanent door buck of the completed bath house. Form panels are set up in batteries of 25 to 50 yoked together with timbers and wedges.

A tapered plug, 1⅞ in. in diameter at the large end and 1⅝ at the small end, is secured to each form at the center of gravity of the slab; the resulting hole, used only for erection, is later filled.

Since the green slabs have no transverse strength it is essential that they be handled entirely on edge. As the slabs are stripped they are lifted on edge and carried to storage on a special hand truck. After three or four days they are taken to the erection traveler shown in the photograph.

For handling the slabs on edge under the traveler a special sling was designed consisting of a ⅝-in. wire rope passed through a 4-in. sheave block. Fastened to one end of the sling is a tapered steel bolt fitting the holes cast in the slab. A wedge secures the bolt. About 100 bath houses per day have been erected by the traveler.

In February 100 slabs were cast each day in alternate ends of a steam heated casting shed. The cost of the concrete bath houses, according to E. L. Sayers, general manager of the Macaday Building Corporation, which is reconstructing the park, is only slightly greater than the cost of wood houses on which the fire insurance rate is $1 each per year.

The work is being done under the supervision of Stewart, Holden & Sayers, consulting civil and mechanical engineers, New York City.

Steel Framing of Narrow Building

Cantilever Foundation Girders Carry Wall Columns for Plate-Girder Floor-Beams Spanning Full Width of Structure

CANTILEVER foundation girders and plate-girder floor-beams which span the entire width of the building and support concrete floorslabs without intermediate steel framing, constitute the distinctive features of steel structural design in an unusually narrow building in Chicago. This is the Waterman Building, for store and retail purposes, which has a frontage of

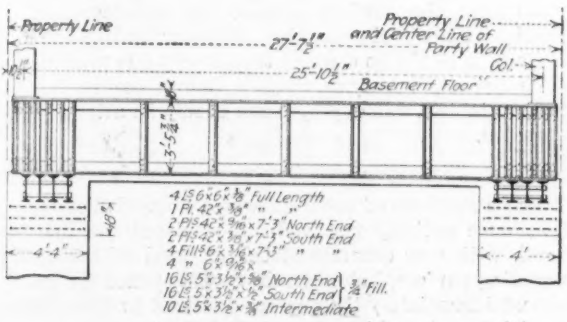


FIG. 1. CANTILEVER FOUNDATION GIRDERS OF NARROW BUILDING

27 ft. 9½ in. on State St., a depth of 148 ft. and a height of seven stories. It takes the place of an old brick and timber structure and had to be erected between existing buildings, with an old party wall left in place on one side.

Along each side were sunk nine open shafts or wells for foundation piers, spaced 18 ft. on centers and extending through stiff blue clay to hardpan at a depth of about 70 ft. below the street grade. These piers are 4 ft. and 4 ft. 4 in. in diameter, belled out at the bottom in the usual way to give the required load distribution of 6 tons per square foot. As a rule, such piers are kept away from the property lines, but in this case their outer surfaces are directly on these lines, which means that the piers on one side extend to the center line of the party wall. The concrete is mainly 1:2:4, but the tops of the piers are of 1:1:2 concrete reinforced with steel hoops and capped with the I-beam grillage to support the girders.

Transverse foundation girders placed upon these piers are 27 ft. 6½ in. long, coming within 3 in. of the lot lines. At the extreme ends of these girders are seated the columns, the cantilever distance between centers of pier and column being 13½ in. for the 4-ft. piers and 15½ in. for the larger piers. This cantilever distance is reduced to a minimum by placing the piers on the property lines, as described. The girders are 42 in. deep, except that those at the ends which carry the walls, but have only half a panel of floor load, are 36 in. deep. Stiffeners and web reinforcing plates are arranged at the loaded ends of the girders as shown, all stiffener angles and fillers being made a tight fit between the flange angles, and the web plates being milled for bearing on the girder shoe plates and the shoes of the columns.

For the columns, an H-section is used in the lower floors, composed of a 12-in. web plate, two 14-in. side plates and four angles. Above the fourth floor this is changed to an I-section, with a single 12-in. web plate.

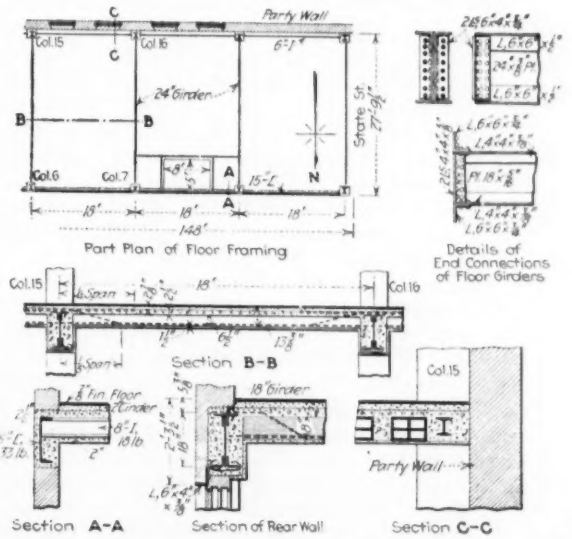


FIG. 2. LONG-SPAN FLOOR CONSTRUCTION WITH PLATE-GIRDER FLOOR-BEAMS

The columns are in two-story lengths. Longitudinal struts are framed between the columns at each floor level, these being 15-in. channels on the side for the new wall and 6-in. H-beams on the side for the party wall. At the first floor the H-beam was omitted, as it was not necessary for construction purposes. An 8-in. channel is placed about 6 ft. above the floor, however, for the support of a tile wall, thus forming a recess for wall cases.

Practically the only steel framing for the floors and roof consists of the row of nine transverse plate-girder floor-beams which are riveted to the faces of the columns. There is, however, certain supplementary framing for the stairways, elevator shafts and skylights. The adoption of plate-girders instead of large I-beams was determined by wind-bracing conditions for this tall and narrow building, more efficient riveted connections for this purpose being practicable with the girders. Vertical angles on the ends of the girders are riveted against the columns, while top and bottom angle brackets have one leg riveted to the column and the other to the flange, thus making a stiff connection. The girders are 24 in. deep, except that 18-in. girders are used in the rear or alley wall, where the load is one-half panel of floor and the wall. These also meet the requirements of window space. A 30-in. girder is used in the front wall at the second floor and above, on account of spandrel requirements.

Reinforced-concrete slab-and-joist construction, with 12-in. tile fillers between 5-in. joists, is used for the

floors and roof, the ceilings being plastered directly upon the tiles and joists. The slab is 2½ in. thick; the total depth over the joists is 10½ in. For the basement, however, a 7-in. flat slab is used. The skylights are of the sawtooth type, with 3½-in. concrete slabs and with glazed fronts facing the north. All floors are designed for a live load of 100 lb. The Waterman Building was designed by Holabird & Roche, architects and engineers. The Dahl-Stedman Co. has the general contract.

Where Is Our Road Program Taking Us?

By J. N. Mackall
Chief Engineer Maryland State Roads Commission

THE highway construction program has reached the point where it will be limited, not by the funds available, but by the availability of materials, machinery and contractors to do the work. Has this situation with reference to funds for construction been formulated with due consideration for the necessary maintenance program? It is the opinion of the writer that it has not, and he believes that this is certainly to some degree attributable to the highway commissioners and engineers.

The opinion is held by a vast majority of people that the funds for the present highway construction program are being invested in "permanent" roads, meaning by "permanent" that they will last for at least two generations. Is there any foundation in fact for such belief? Have concrete roads, either plain or reinforced, given any indications of a life of 25 yr. or more, and have any bituminous pavements, even the highest type, sheet asphalt, when subjected to heavy traffic, given any such indications? With a few exceptions, it is the opinion of the writer that they have not.

For proper financing, it seems a fundamental fact that the roads should be constructed, in the first instance, from the general funds, and should forever thereafter be maintained from current receipts, even though that maintaining requires resurfacing, or even rebuilding. Any course other than this will lead to ruin. If the funds from motor vehicles are used to float bond issues, the maintenance fund is cut off. On the other hand, if the general fund is used for maintenance, it will eventually bankrupt the government.

Concrete Considered Best Construction

The principal form of construction now being used, and in the opinion of the writer, the very best, is cement concrete; but it is best because it is going to give a long life at low maintenance, and by long life the writer means from 10 yr. on very heavy-traffic roads to 15 or 20 yr. on moderately heavy-traffic roads. When it reaches the point where it no longer can be economically maintained as a concrete road, it can be resurfaced with some form of good hot mixed bituminous pavement to give another period of long life, conserving the entire initial investment, instead of having to be "junked," as has been the experience in the past with many broken-stone roads, whether constructed as water-bound macadam or as bituminous macadam.

Maryland is now confronted with the problem of resurfacing some of its earlier concrete roads which have given satisfactory wear for a period ranging from 7 to 10 yr. During 1919, the commission resurfaced 2.8 mi. of the Baltimore-Washington Road, which was constructed partly of concrete and partly of penetration macadam, and 1.5 mi. of road leading to Camp Meade, which was constructed of hassam compressed pavement, in 1914. Further sections of the Baltimore-Washington Road will need to be resurfaced in 1920, notably the section through the village of Elkridge, 1 mi. in length, and the section from the District of Columbia line to Bladensburg, 1.5 mi. in length.

Failure of the concrete sections on the Washington Road was due for the most part, not to poor subgrade, nor to insufficient depth of concrete, but to the disintegration of the surface. This disintegration was such as to force the belief that it was due to "fatigue," and if this conclusion is correct, then it is the writer's opinion that the use of light metal reinforcement, or the adding to the depth of the concrete over the present depth of 6 in. at the side and 8 in. in the center, is not going to add materially to the value of the concrete as a pavement. The writer has used the word "fatigue" for the want of a better term to describe the failure. The disintegration of the surface appeared at a number of points throughout a section simultaneously. At each point of failure the rupture in the surface was small in size at the beginning, but soon developed very considerably in size and depth, which demonstrates that the actual point of failure is only infinitesimally weaker than the adjacent and whole surrounding section, and when once the surface breaks, the disintegration is rapid. If the disintegration were confined to the top surface, it might be claimed that it was due to abrasion from impact, but since when a failure occurs, it progresses in area and depth, it can hardly be attributed to abrasion.

Disintegrated Concrete Replaced

These sections of concrete which showed disintegration were entirely removed and replaced for the full depth with new concrete struck off level with the surrounding surface, but when they were opened for traffic, almost immediately the surface adjacent to them began to disintegrate, which showed that there was no longer very great resistance left in the adjacent concrete, and it is believed that it can be saved only by resurfacing with a good bituminous pavement. It will be resurfaced during 1920 with a standard sheet asphalt pavement, consisting of 1½ in. of binder and 1½ in. of topping.

The question as to when a concrete road is "worn out" has never been definitely answered, but the failures on the Washington Road have shown that, when a concrete road reaches the point where patching with concrete is necessary (except, of course, failures from poor subgrade), it is worn out, and cannot be longer economically and successfully maintained as a concrete pavement, but only as a concrete base for some form of bituminous top.

Let it be understood, however, that this commission is entirely satisfied with its concrete pavements and that its decision to build extensively concrete pavements at this time was reached with a full knowledge of the failures in the concrete section as noted above. There is no other type of pavement so far developed, which, at little or no maintenance cost, would have given from 7 to 10 yr. of wear under the tremendously heavy traffic on the Baltimore-Washington Road, which could still be resurfaced with sheet asphalt to give another period of long life, thus conserving the entire initial investment. This, too, despite the fact that this concrete was considered good concrete when it was built, but would not be considered first-class concrete as we know concrete roads today.

Corrosion of Steel in Concrete Roof Over Dry Kiln

Failure Due to Combination of Poor Concrete Weak Design, Cinder Fill and Heat and Moisture in Kiln

By Alvin H. Weber
Henry C. Weber Construction Co., Bay City, Mich.

POOR design and construction added to certain adverse conditions of service combined to cause the recent failure of a reinforced-concrete roof to a dry kiln. The subsequent investigation revealed some facts which should be considered in similar design and construction.

The roof was approximately 18 ft. span, made up of 10-in. terracotta tile and 4-in. concrete joints, with no concrete over the tile, but instead an 8-in. layer of soft coal cinders was pleced over the tile for insulation and over this was a 2-in. layer of concrete. The under side of the slab was covered with cement plaster ½ in. thick. The wood dried was maple and the temperature varied from below freezing with the kiln open in the winter to a maximum of 170 degrees.

The first sign of any undesirable action, occurring two years after the completion of the work, was the cracking of the plaster followed almost immediately by leakage in the roof. A tar and gravel roof over a wood substructure was put over the slab to prevent the leakage and it was some time after this precaution had been taken that failure occurred.

The investigation of the failure brought out several facts. The aggregate was of a very poor mixture and the amount of cement used was entirely inadequate. The 10-in. tile and concrete joists together with the steel were adequate to carry the load across the span but at certain intervals along the walls there was no bearing owing to the fact that the vent flues passing up through the roof were flush with the walls and at these points no header was framed across this non-bearing interval to the bearing joists on either side, leaving a section of slab 3 x 8 ft. without any support and held in place only by arch action. Failure occurred at several places simultaneously though some of the sections did not fail entirely but remained intact and had to be broken down.

The most important revelation of the investigation was brought out by an examination of the reinforcement. Several bars were examined and at the center of the span the cross section of what had been a ¾-in. square twisted bar was less than ½ in., tapering almost uniformly to the original cross section at either end of the span. A further investigation of the twists showed that there was very little if any stretch in the bars. A final fact which has some bearing on the conclusions was the condition of the metal hoppers which diverted the roof water into the conductor pipes. It was found that the original hoppers were of galvanized iron and corroded so quickly that they had to be replaced in a very short time. Copper was substituted and at the time of the failure these hoppers were corroded to some extent but the action had been slower than in the case of those originally installed.

The preliminary conclusion to be drawn was that for some reason the concrete had cracked to such an extent that the steel was exposed to corrosive influences of some nature. With safe working limits there is no danger from corrosion on account of fine cracks due to tension or expansion in a reinforced beam or girder. Therefore these must have been comparatively large cracks, which were due to poor concrete, violation of the fundamental principles of reinforced-concrete construction, and perhaps, to extreme variations in temperature.

The effect of water trickling through the cinders after the roof started to leak seems to be negligible. Cases of serious corrosion of steel imbedded in cinders are on record but in this case the steel was not imbedded in the cinders and the only possible action due to the presence of this material would be the formation of weak acid solutions as the water passing through the cinders united with some of the impurities. Sulphuric acid would be the most easily formed and most destructive but a chemical analysis of soft coal cinders shows the presence of but 0.83 per cent of sulphur so that in the worst possible case this effect on corrosion would be small. Considering the fact that the leakage through the roof was allowed to continue only for a short time, the corrosion due to the formation of acids or soluble salts may be considered as having little effect in this particular case.

The hopper corrosion, which must have been caused by action from below the slab, was due partly to the action of the heat upon the wood, forming certain destructive chemical combinations. This would seem to be verified by the fact that even after the substitution of copper for the original material a certain amount of corrosion occurred. The effect of this influence upon the steel bars could not be determined but there is no doubt that it has some effect and the writer is inclined to believe that the pitted condition of the corroded bars was largely due to this influence. The greatest accelerator of the corrosion was without a doubt the heat and moisture present in the kilns.

Tests of Wooden Struts

Compression tests of 82 spruce struts of sizes corresponding to those used in aeroplane construction were made recently at the Bureau of Standards, and the conclusions therefrom are reported in the Bureau's "Technologic Paper 152" by Prof. J. E. Boyd. These struts were about 1¾ in. square and ranged from 12¾ to 126¼ in. long (slenderness ratios 25 to 250). From the results it is concluded that a formula of Rankine type as follows:

$$\frac{P}{A} = \frac{5200}{1 + \frac{l^2}{3000r^2}}$$

gives satisfactory results for short columns (below slenderness ratio 80), while for longer columns the Euler formula

$$\frac{P}{A} = \frac{16\ 000\ 000}{(l/r)^2}$$

may be used. These formulas apply to round-end struts, which means practically to all actual working conditions. Where the ends of a strut are fixed or have square ends "accurately fitted to rigid supports" the Rankine formula should have its denominator constant increased from 3,000 to 12,000.

It is also concluded that the modulus of elasticity of the wood may be conveniently determined by compression tests on very long, round-end struts, with slenderness ratio of 200 or over, applying Euler's formula to the result.

Methods Employed in Sinking Large Open Caisson

Depth of Final Penetration Controlled by Friction Collar—Winter Concreting Made Safe by Heated Housing

METHODS of general applicability were developed in sinking a large open caisson at Milwaukee last year, to attain certain essential objects: (1) check the settlement of the well at a specified level by artificially increasing the soil resistance, (2) control the groundwater pressure in closing the bottom, and (3) carry on concreting in winter weather without loss of quality of concrete. Construction of a dense water-tight shell in cold weather was the first requirement of this work. A second requirement was that a tight bottom must be placed against a rising pressure of water and without disruptive stresses from the water until the concrete had attained strength. The main governing condition was that the caisson must be brought to rest with precision since the wall inside contained a number of recesses into which future floor slabs and partition walls were to be fitted at prescribed elevations.

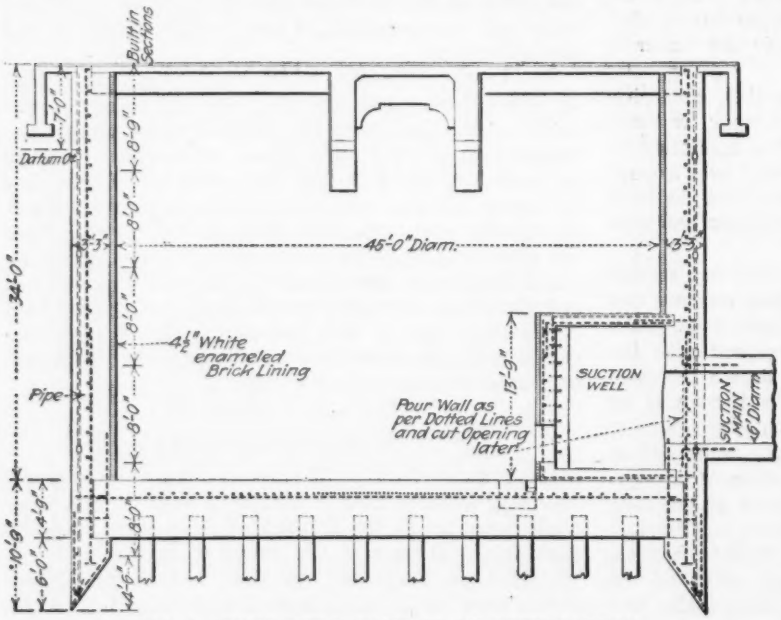


FIG. 1. PUMP WELL SUNK AS AN OPEN CAISSON

The caisson forms the outside wall of a pump well for the new Jones Island sewage disposal plant, being constructed by the Sewage Commission of the City of Milwaukee. A transverse section of this pump well is shown by Fig. 1. The portion sunk as caisson was the concrete cylinder, 3½ ft. thick and 52½ ft. in outside diameter. The depth from top to cutting edge was 44¾ ft. The soil penetrated was 17 ft. of sand and then 22 ft. of marsh muck overlying another stratum of sand, into which the cutting edge penetrated. Groundwater level was about at datum, 7 ft. below the top of the caisson. The ring and the cutting edge were reinforced, but no metal shoe was used on the cutting edge. At sixteen equidistant points around the ring, 1¼-in. pipes opening out on the inside slope of the cutting edge were embedded, to be used, if necessary, for water jets to facilitate sinking. These pipes were never employed for jetting. Construction was begun by concreting a section 8 ft. high resting on a ring of planks on the bottom of an open pit, as indicated by Fig. 2. To start sinking, the planks were chopped through close to the cutting edge. Excavation was then begun by a derrick-operated clamshell bucket. When the first 8-ft. ring had settled to the required depth, forms were erected and a second ring was concreted. Then the excavation and sinking were resumed. Repetition of these operations completed the sinking until near the bottom. At no time was any weight added to the concrete to make the caisson sink, and until near the bottom no other means than excavation with the clamshell was required to keep the ring going down and on an even keel.

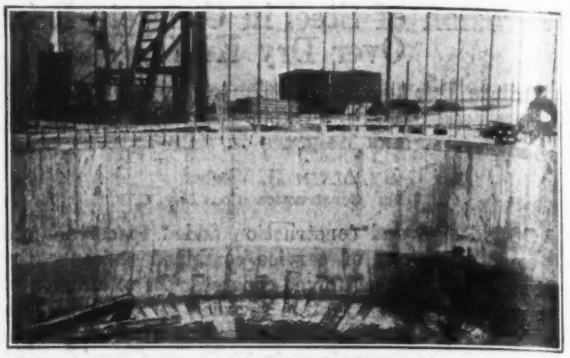


FIG. 2. CUTTING-EDGE SECTION COMPLETED AND READY TO BE SUNK

Control of the sinking was planned to ensure (1) that the caisson should come to a full stop at a specified elevation and (2) that it be as nearly plumb as possible when it assumed this final position. Careful maintenance of the level of the cutting edge at all times from the commencement of sinking was the first step toward ensuring the two results sought. From

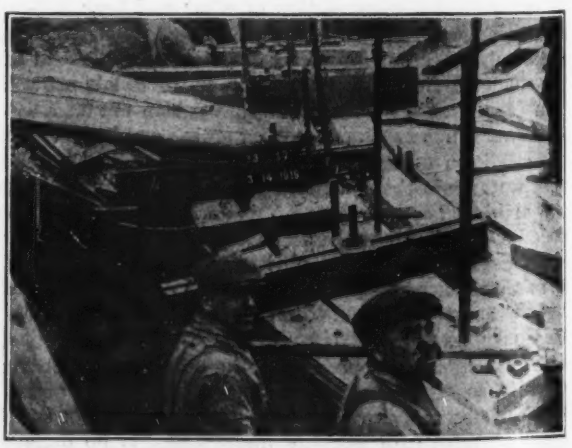


FIG. 3. BRACKET BEAMS FOR TIMBER FRICTION COLLAR

an outside point, level sights were constantly taken on filled marks on the sixteen jetting pipes projecting above the top of the concrete ring. Ordinary hose clamps were placed on the pipes at the marks and the readings taken by holding the rod on the clamps. These were raised as each addition was made to the ring so that always the ring of clamps was exactly parallel to the cutting edge. On one occasion the ring settled a maximum of 1 ft. out of level but ordinarily the difference was only a few inches and was corrected immediately by shifting the excavation toward the high side.

As the final depth was approached, provision was

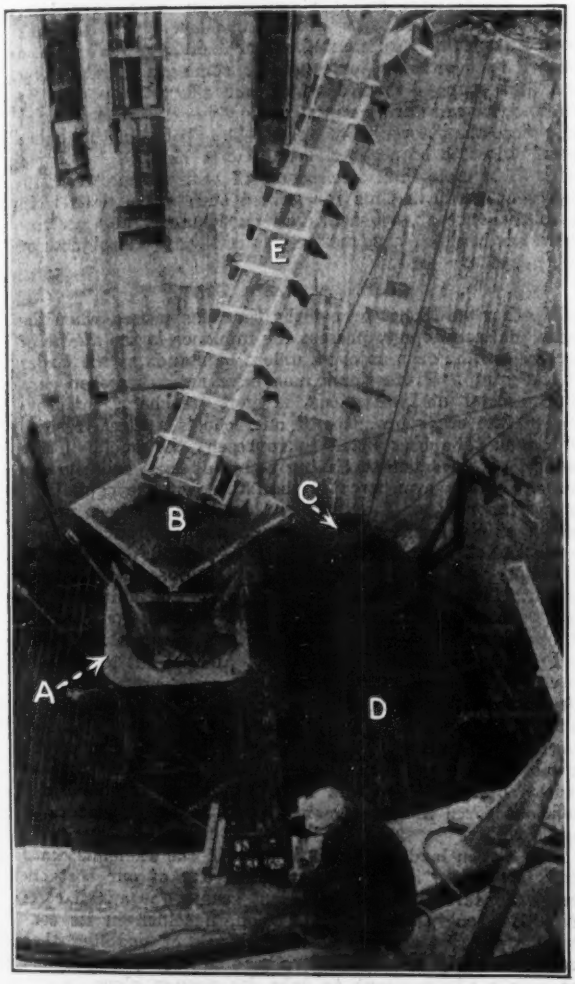


FIG. 5. CHUTING ARRANGEMENT FOR DISTRIBUTING CONCRETE TO FLOOR SLAB

made to check the settlement and to hold the ring at the prescribed elevation while the excavation for the bottom was completed. An exterior bracket was constructed around the caisson just below the final 8-ft. ring, radial steel beams (Fig. 3) were placed at intervals around the ring, projecting out about 2 ft., and under their projecting ends was placed a circle of timbers. With the additional vertical bearing of this bracket it was estimated that the caisson would settle 1 ft. to the required elevation when the final ring of concrete was placed on the top. To maintain the level in the final sinking, jet pipes connecting a 2-in. hose with 1-in.

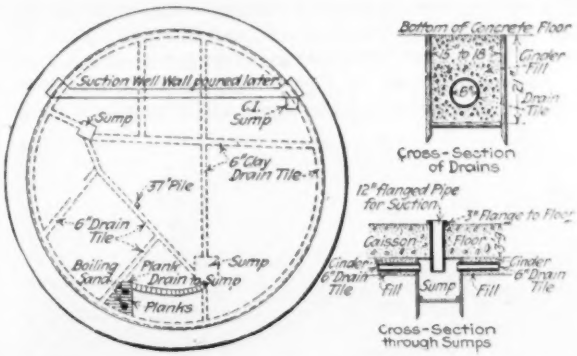


FIG. 4. DRAINS KEPT BOTTOM FREE FROM WATER WHILE CONSTRUCTING FLOOR

pipe ends were worked down along the high edge as occasion necessitated. When brought to a stop the caisson was 3 in. high, 2 in. out of plum and 1½ in. off center. The circumferential brake had proved slightly more effective than was anticipated but yet had stopped settlement well within the limits of error provided for in molding the interior recesses for slabs, girders and partitions and by leaving the top of the last ring 6 in. low.

Piles for the floor foundation were driven by a steam hammer hung from the derrick boom, after all the concrete had been poured and the caisson had come to rest. No appreciable settlement was caused by the driving of the piles.

The bottom was about 1 ft. of marsh muck overlying sand and fine gravel carrying water. Drainage of the bottom was the first necessity in placing the concrete floor. Fig. 4 shows the arrangement of drains adopted. In only one place did these drains fail to keep the water down. Here it boiled up alongside two piles, and a special plank drain was built. The plank was covered with several inches of dry cement and the concrete was placed on this, which forced the water through the drain. With the pumps working, the concrete floor was placed. The water was then allowed to rise and cover the floor to datum for one month until it had set and gained strength. Finally the water was pumped down, the pipes were capped and the sumps and drains filled with grout forced in under water pressure through 2-in. pipes tapped into the flanges. The completed floor was watertight.

The plant arrangement for concreting the bottom proved particularly convenient. On a tower set on four piles arranged about the center of the bottom circle a braced tower was erected as shown by Fig. 5. On a small platform *A* at the top was set a frame holding a hopper *B* with an attached radial chute *C*. The frame was pivoted and set on a ring of casters so that the hopper could be rotated horizontally. From the radial chute *C* the concrete flowed to a portable chute *D* which delivered to the floor slab. By this arrangement con-

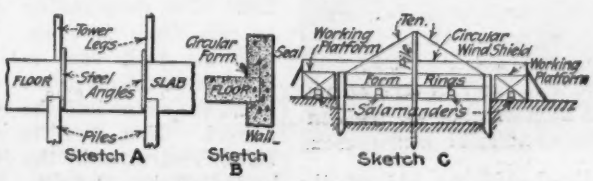


FIG. 6. WINTER HOUSING OF WORK AND MINOR CONSTRUCTION DETAIL

crete was delivered by direct chuting to any part of the slab. The hopper received concrete through chute *E* from a battery of three mixers arranged at the top of the caisson as shown by Fig. 7. So as not to interfere with the concreting of the floor, the tower legs were

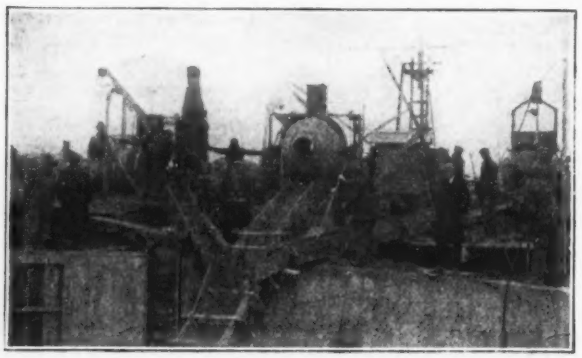


FIG. 7. BATTERY OF THREE MIXERS DISCHARGING INTO SINGLE CHUTE TO HOPPER

supported on the piles by means of angles attached as shown by sketch *A*, Fig. 7. The angles were cut off and left embedded.

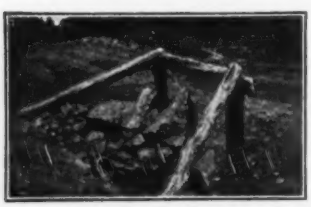
Another detail of the floor slab is indicated by sketch B, Fig. 6. To allow for irregularities in sinking the caisson the inside slot for the floor slab was made higher than the depth of the floor, which left a circular space to be filled. A circular form was set as shown by the sketch and behind it the cavity was filled with grout.

Winter concreting was accomplished without a single failure, by an adaptation to the conditions of well-known practices. The sand, stone and water were heated by steam coils and jets; the mixed concrete entered the form rings at 50° to 70° F. Around the caisson a circular windshield was erected as indicated by sketch *C*, Fig. 7. Inside this shield was a working staging and runways. Salamanders set under the staging kept the outside forms warm, and others located inside the ring kept the inside forms warm. The top of the caisson was tented over as indicated by the sketch, and the top edge of the concrete, where pouring was not in progress, was kept covered by planks and hay.

The construction described was performed by Klug & Smith, Milwaukee, Wis., contractors, for the Milwaukee Sewerage Commission, T. Chalkley Hatton, chief engineer. G. R. Young was division engineer during the first part of the operation and later was succeeded by R. R. Lundahl. H. E. Nichol was resident engineer.

Simple Barrier Protects Mountain Culverts

Culvert inlets on the uphill side of the mountain road in Idaho entering Jackson Hole by the Teton route are protected by the railing shown in the cut.



During the winter the log rails mark the road limit. The slope leading to this drain is steep, and the rock dam is essential to the diversion of all the water into the culvert. This road is being constructed by the state, with the aid of the United States Forestry Department.

The Ultimate Aim of Engineering Organization

(Extracts from a Paper Presented to the Michigan Engineering Society by Louis E. Ayres, Ann Arbor, Mich.)

WHEN the wave of enthusiasm for engineering organization, which has been sweeping over the country for the past two years has passed, what then? In four or five years a great percentage of the engineers will have joined some society, local, state or national. Perhaps in five years all of us may have become affiliated in a single national unit. By that time most of the objects that are held commonly in mind today as among the purposes behind the present spirit of co-operation—better wages, greater public recognition, suitable registration—will have been accomplished. Will this great movement then, its work done, its objects consummated, suffer disintegration? Unless we can discover some worthy object, some great and lasting aim and purpose toward which our efforts may ever be directed, we can hardly expect to survive as a large national unit more than a very few years. It is believed that there is an object to be accomplished that is big and worthy, a work to be done than transcends all selfish interests. The fact that we have thus far gained such an impetus is in itself evidence that beneath all our interest and activity there has been a subsconscious realization of the bigness of our purpose.

Must Speak as a Unit

Whether we like it or not the time has passed when the individual can hope to possess the influence in the affairs of society that he once enjoyed, unless he stands as the leader of the group. Professional men have not yet spoken as a single social unit. Doctors, lawyers, teachers, engineers and all the other products of our schools and universities who *should* be best fitted to represent the public in the counsels of government, having rights at least equal to and responsibilities even greater than those of the capitalists, or the laborers, or the farmers, have not yet been united into a single social class. Let me suggest that the perpetuation of democracy as we know it will depend upon whether or not these classes of our society become organized as units for social and political purposes and united in the great common aim of public service. Unless our educated and professional classes make a study of the social, economic and political problems of democracy and set out to put into force and effect those measures and movements necessary for their solution, democracy will disappear. No one anticipates that we will ever experience a soviet regime in America, but we are likely to suffer from the domination of one or more of its organized classes unless the other units of society, of which you and I are members, can become a sufficient force in government to act as the defenders of public rights.

To assist in leading our nation out of the economic chaos that now exists is surely a task worthy of our best endeavors. Herein lies the greatest reason for an all comprehensive engineering organization, unselfish in its controlling purpose and equal to the task of enabling that profession which has heretofore been so largely responsible for man's advancement to take its proper place in the larger sphere of opportunities afforded by a new world and a new social order. Let not my intention be misunderstood. I am not advocating that all engineers abandon at once the technical work by which they earn their livelihood. Not in the least. I do fully expect, however, that a portion of the profession should and will give more attention and study in the future to social, economic and political matters, and some of us who are in a position to do so will devote a large portion of time to public affairs. If as a class we become effective we must develop leaders, men, as Roosevelt put it, "to whom are granted great visions, who dream greatly and strive to make their dreams come true; who can kindle the profession with the fire from their own burning souls."

In national affairs there is no reason why a national society of engineers may not at an early date gain recognition from our federal government and, on a par with the

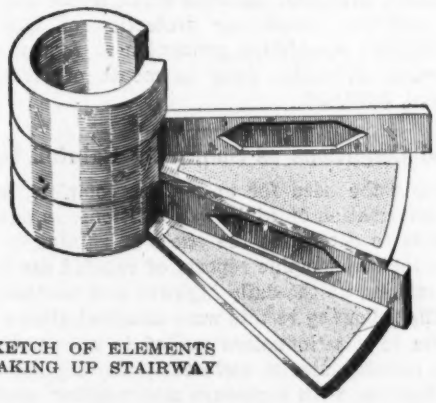
representatives of organized capital, labor and agriculture, assist in the solution of the national problems and the determination of national policies. Let it be emphasized, however, that our power must never be used for a selfish purpose or it will soon come to naught. We must teach, preach and live the doctrine of service. Service must be our motto. It is what I put in that counts, not what I get out. It is what I do and give that makes me rich, not what I receive. We are a profession and, as the doctors have expressed it, "a profession has for its prime object the service it can render humanity; reward or financial gain should be a subordinate consideration." Let us make articulate the voice of service.

We need to support all good laws and oppose bad ones, regardless of whether our own rights or privileges are concerned. On election day we should be found at the polling booths, conversant with the issues at stake and the candidates in the race. In short we should be American citizens in every sense of the word, and as individuals and as a unit intent upon the promotion of Americanism.

Is this too big a job for you and me and for the 200,000 or more engineers scattered throughout our country? I think not. I cannot help but feel that in the subconscious minds of many of us has been at work just such a conception of the ultimate purpose of engineering organization.

Spiral Stairway Made of Precast Concrete Members

IN the new Welland Canal locks a mooring gallery runs longitudinally through the lock wall for its full length at an elevation about 30 ft. below the top of the well. Through openings into the lock from this gallery boats are moored during the locking operations and as



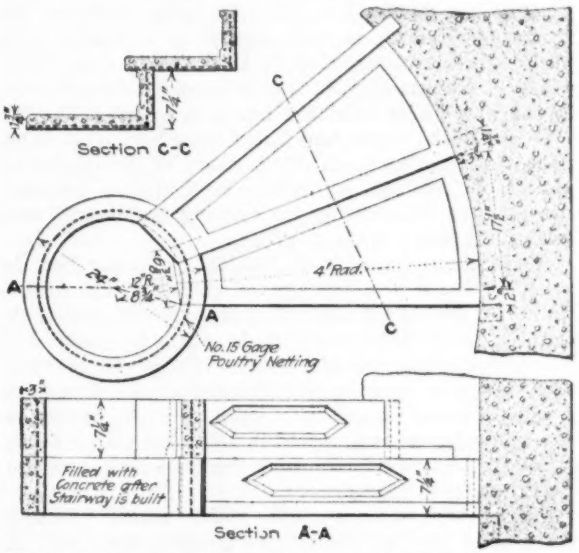
SKETCH OF ELEMENTS MAKING UP STAIRWAY

the water rises the lines are cast off of the bollards and the men go up through stairways to the top of the lock. These stairways for the larger part of the 30-ft. depth have been built in spiral form of precast concrete members, according to the details shown in the accompanying drawing.

In building the lock a cylindrical opening 8 ft. in diameter is left from the mooring gallery floor to the lock-wall top. With the exception of the lower 6 ft., which is in straight stairway, the whole staircase is in spiral form rising around a central concrete column made up of precast hollow cylinders with each step a precast concrete piece comprising a tread and the next higher riser.

The supporting cylinder blocks are each 2 ft. in outside diameter with 3-in. walls 7¼ in. high, reinforced with No. 15 gage chicken wire. A radial opening is left in the wall of this annular ring of sufficient size to admit the stair unit. This stair unit, as shown on the detail, is sector shaped with the riser protruding 3 in. beyond the plane of the tread, this protruding end being left to take bearing in a groove cut in the cylindrical wall of the opening, into which it is grouted after the stair unit is placed.

In construction the first cylinder support piece is placed with the stair section fitting into the opening. The next higher center cylinder block is then placed



DETAILS OF NARROW PRECAST CONCRETE STAIRWAY FOR WELLAND CANAL LOCK WALL

on top of the first and turned radially in a horizontal plane just sufficient to place the opening in the proper position to engage the next higher stair unit. The staircase is erected in this manner in successive units clear around the double turn to the top of the lock wall. After all the units are placed the opening in the cylindrical block support is filled with mass concrete.

In addition to the precast pieces for the spiral stair unit a precast tread 12¼ in. wide and 1¾ in. deep is made for the straight approach section to the spiral staircase.

The Welland Ship Canal work is in charge of Alex. J. Grant, engineer in charge, St. Catharines, Ont.

Army Appropriation for Alaska Road Work

Despite the unusual effort made by those interested in Alaska to increase the military road-building program in the territory, the Army appropriation bill was reported to the House carrying only $150,000 for that purpose. The sum of $422,000 was asked. The Alaska road commission has constructed since its organization in 1905, 1,031 mi. of wagon road, 636 mi. of sled road, and 3,225 mi. of trail, a total of 4,890 mi. of transportation route, together with a large number of bridges. This construction work and maintenance charges had cost up to July 1, 1919, $4,923,576.93.

In addition to Army appropriations, funds for road building in Alaska are obtained from trade and occupational licenses, from which source the road commission obtains about $125,000 per year. Then, the territory of Alaska provides some $225,000 per year for road construction, 80 per cent of which is turned over to the road commission.

Report of the Kaw River Flood Protection Problem

Improve Channel by Removing Buried Bridges and Wreckage—Dredging Not Advocated as Deposits Will Scour

FLOOD protection works which will give the Kaw River at Kansas City, Kan., capacity sufficient for such a great flood as that of 1903 at a cost of only $400,000 are recommended by C. E. Smith, consulting engineer, Kansas City, Mo., in place of works proposed by the Kaw Valley Drainage Board at a cost of $1,500,000. After the voters had failed to authorize the bond issue for $1,500,000, in 1919, some of the property owners engaged Mr. Smith to investigate the problem. His plans provide mainly for clearing the channel and raising the levees from 2 to 5 ft.

A discharge capacity of 306,500 cu.ft. per sec. is assumed, being the average of estimates by fifteen engineers, and as the flood discharge of 1903 was from 250,000 to 280,000 cu.ft. it is concluded that the theoretical cross-sectional area of 28,980 ft. is sufficient, but must be secured and maintained. This area is for a channel cleared to a depth of 45 ft. below the tops of the levees as proposed in 1904, but such a depth has never been obtained. Blue clay and rock limit the scour line to 45 ft.

During low water periods, which extend through the greater part of the year, a considerable width of the river bed is dry and has become covered with willows. This growth causes sedimentation during high water and also prevents scour of the deposit, so that there is a continual process of ascretion. The areas thus overgrown must be cleared and kept clear, in Mr. Smith's opinion, in order to reduce the deposit of silt and to facilitate scouring by floods.

Obstructions in the river bed are another cause of the prevention of scour which ordinarily would take place during high water and would thus automatically enlarge the channel capacity when necessary. These obstructions are of an extraordinary character, including bridge trusses and girders, bridge piers, riprap, railway cars, barges, piling and other wreckage brought down by floods and now buried in the silt. Such wreckage should be removed promptly and the report recommends a complete examination of the river bed by means of a barge equipped with jet pipes, thus loosening the deposit and locating obstructions. A fill forming the approach to one of the bridges obstructs the channel and this should be replaced by a trestle pending the result of litigation over changes in the bridge.

In his conclusion that no general scheme of dredging is necessary, Mr. Smith differs from the engineers of the Drainage Board and agrees with earlier reports of the U. S. Engineer Corps. He considers that the expense is not justified for the purpose of locating obstructions and decreasing the cost of their removal. On the other hand, with the obstructions removed there will be no necessity for derdging since the floods will readily scour out the channel to the hard bottom. Further, the Kaw River carries a great amount of sediment and during low water periods the conditions are ideal for depositing this material, so that a dredged channel would soon be filled. Measurements taken late in 1918 and after the spring runoff of 1919 showed that scour due to this runoff had increased the cross-sectional area of waterway by 2,000 to 3,000 sq.ft.

For the levees, a raise of 2½ to 5 ft. is advocated, instead of the general raise of 5½ ft. as planned by the Drainage Board. Rock revetment would be used on the lower part of the slopes and on the concave side of bends. This rock may be deposited in a mass along the low water line and will then fall and spread over the slope when the water begins to scour below that line. Although twelve bridges are below the Board's new levee elevation, Mr. Smith advocates leaving eleven of these until flood conditions demonstrate the necessity of raising them.

As the low lands known as the West Bottoms, occupied by industries and forming a peninsula between the Kaw and Missouri Rivers, are partly in Missouri, the report recommends that the Drainage Board should negotiate for extending the levee work along the river front in Missouri in order to protect property in Kansas. An opening for the discharge of Turkey Creek must be left until the completion of the Turkey Creek sewer which will divert the flow from the present open channel. As the Kaw River is almost at right angles to the Missouri, a dike or jetty at the mouth of the former is proposed in order to deflect the flow into the direction of the current of the latter, but the land in that vicinity is not considered of sufficient value to warrant the cost of protective works as planned by the Drainage Board. A summary of Mr. Smith's estimate of cost is as follows: Removing obstructions from the channel, $100,000; concrete walls, levees and revetments, $89,752; completing protection of West Bottoms, $81,000; completing protection at Argentine and Armourdale, $104,248; jetty at mouth of river, $25,000; total, $400,000.

Road Conditions as Shown by Rainfall Data

Realizing the need for up-to-date, complete, and accurate information on highway conditions, an effort has been made to determine the effect of rainfall on highways so that telegraphic reports of rainfall can be utilized in making up the daily highway and weather bulletins. The following results were obtained after a study of replies to questionnaires mailed to co-operative observers, correspondents, meteorologists, engineers, and others familiar with highways and weather conditions in the communities in which they live. The results apply to dirt roads in Arkansas and mainly to spring, late autumn and early winter conditions.

It should be remembered that all the results are averages, and that only reliable estimates in measurable amounts of precipitation were used to obtain the figures. The average opinion of the correspondents is that 1.38 in. of rainfall make dirt roads muddy; those located in the lowlands estimated that 1.13 in. was the required amount; in the uplands 1.51 in. They estimated that 2.78 in. of rainfall make dirt roads very muddy; those in the lowlands, 2.25 in.; and those in the uplands or hills, 2.9 in. The variations for surface conditions is 29 per cent in both instances. It is interesting to note that it requires about twice as much rainfall to make certain roads very muddy as to make them muddy. The estimated amount required to make dirt roads impassable averages 4.04 in., varying from 3.57 in. for lowlands to 4.35 in. for the hills and uplands—*Monthly Weather Review.*

Drainage Results and Proposals on the Salt River Project

TRIAL drainage wells sunk in typical seeped areas on the Salt River Irrigation Project, Arizona, last season have proved successful in lowering the ground water levels. In consequence a plan has been formulated to provide drainage for the five principal districts seeped or threatened with seepage. In April a bond issue of $400,000 will be voted upon to provide the funds in accordance with the recommendations of D. W. Murphy, consulting engineer, Los Angeles, who submitted a report to the Water Users' Association in February.

A consulting board, consisting of W. H. Code, W. R. Elliott and Mr. Murphy, in February, 1918, found that in five years there had been an average rise of 7.5 ft. in the ground water level, sufficiently high over a large area to be a source of danger. On the board's recommendation wells were sunk and motor-driven pumps installed on three separate areas.

Mr. Murphy finds from readings taken on wells during October, 1919, 43,000 acres of lands damaged or threatened as it was learned that the ground water level was 10 ft. or less below the surface. During the past two years readings over the whole project have been taken. A typical record is the average of 16 wells on the Laveen area: October, 1918, 8.2 ft. to ground water; May and October, 1919, 9.7 and 8.8 ft. respectively. From the three separate areas supplied with wells installed and pumps available for operation in 1919, the results are as follows: (1) On an area of 25,000 acres on the "south side" the average lowering from May to October, 1918, was 3 ft. From May to October, 1919, it was 2.5 ft. (2) In the vicinity of the Grand Canal north of Phoenix 1,493 acre-feet was pumped from four wells in the period from Sept. 1, 1919, to Feb. 1, 1920. The results showed over an area 1½ x 2½ miles in extent, the average elevation measured in 24 test wells being 4 ft. lower than in May, 1919, and 2.4 ft. lower than in October, 1918. Six test wheels on adjacent unpumped areas indicated a rise of 0.4 ft. since May, 1919.

Conditions on the five principal areas needing drainage vary according to the material underlying the surface and will be handled differently. From logs of various wells it was learned that the Tempe district is underlaid with caliche to a depth of 50 ft. Below the caliche porous water-bearing gravels are found and the high ground water is due to the upward pressure from the water in the gravel layer.

Only pumping of wells can be effective through the caliche. Drains of any practical depth are of little use. The Laveen area is a flat depression one mile in width at its widest part. The formation consists principally of clay and caliche, broken by thin strata of sand, gravel and mountain wash through which ground water percolates slowly to the lower position of the area. Since there is no deep lying porous gravel beds, deep drains only will answer here for the ground water lies on top of the more or less impervious clasp. The Salt River and the New River areas are seeped from percolation from higher ground. Drainage can be effected by intercepting this percolation with a line of wells and also a deep drain tapping porous sands and gravel through the lower portion of the area. The seepage accumulated contains large quantities of alkali and a drain is the only effective means of leaching out these salts.

The most difficult tract is a portion of the Arizona and Grand Canal area on which some wells have already been installed. Careful observations and studies must be made as the work progresses. The formation to considerable depths is principally caliche, clay and mountain wash, none of which is a good water bearing material. The strata of sand and gravel are thin and the water under pressure moves freely but in small quantities. The strata are too deep to be tapped by drains and a large number of small wells yielding about ¾ sec.-ft. each seems to be the only feasible method of drainage.

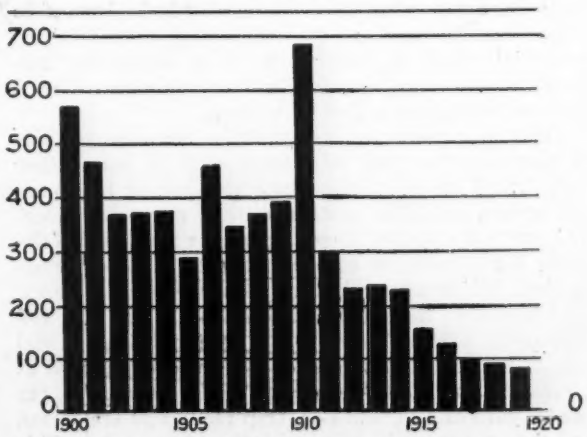
Since the quantity pumped may be in excess of irrigation requirements and may have to be removed during the non-irrigating seasons, as well as being unsuited because of alkali content, 25 miles of waste ditches are provided. Mixing alkali water with several times its volume of river water will bring the resulting dilution in many cases within usable limits, but frequent analysis of each well is then essential.

Utilization of the ground water to the full as an additional water supply to supplement the reservoir water will require additional pumps over those which it is proposed to install at first as a minimum for drainage only, since to accomplish the drainage it may be necessary to pump all or a greater portion of the time.

This work is being carried out under the direction of W. R. Elliott, project manager, Salt River Valley Water Users' Association.

Reduction of Typhoid Fever in Minnesota

THE reduction of typhoid fever in Minnesota during the past 20 years is shown by the accompanying diagram, taken from a leaflet being circulated by the Minnesota State Board of Health. In 1910, the highest year shown on the diagram, the Legislature appropriated to the State Board of Health for a pure water-



DEATHS FROM TYPHOID FEVER IN MINNESOTA FROM 1900 TO 1919, INCLUSIVE

supply campaign the sum of $5,000 for work in 1911, while for 1912 an appropriation of $7,500 was made for the sanitary engineering work of the Board. From 1912 to date the appropriation has been $7,000. In 1914 the Engineering and the Laboratory divisions of the board were merged and since that time the work on water supply and sewerage systems has been conducted by the Division of Sanitation of which H. A. Whittaker is director.

From 1900 to 1910 the average typhoid death rate in

Minnesota was 428. In 1910 there were nearly 700 deaths and 14,000 cases of typhoid in Minnesota, while in 1919 the deaths numbered only 82 and the cases about 1,640. The population of the State has increased materially during the time covered by the diagram.

The leaflet already mentioned gives credit to the Division of Preventable Diseases as well as to that of Sanitation for the reduction of typhoid effected. The leaflet also states: "Investigations made by the Division of Sanitation show that there are as many water supplies that are as unsafe (today) as those which have previously caused epidemics."

Waterbound Macadam and Bituminous Concrete Roads Rejuvenated

By Charles F. Puff
Assistant Chief Engineer, Bureau of Highways, Philadelphia, Pa.

With the development of the automobile it became apparent at once that waterbound macadam pavements would be of no value unless something were done to protect the surface, therefore bituminous surface treatment came into use. For the past 10 years waterbound macadam roads have been surface treated with tar and asphalt applications, which transformed these old dusty, pot-holed or loose stone highways into surfaces as smooth as sheet asphalt. At one stroke, dust was eliminated, the metal of the road remained in place, smooth riding was furnished and considerable money was saved in maintenance.

With the accomplishment of smooth and dustless riding, the engineer once more settled into a study of the good and bad features of the various characters of bituminous treatments and surface coverings and at present it is developed into an important factor in the science of road maintenance. Treatment after treatment was applied, but when the number had advanced to ten, it became apparent that there was a limit to the beneficial effects of this work. The bituminous material became wavy, rippled and corrugated and once more new methods had to be evolved.

The first remedy for this condition we employed was to resurface the road to a depth of 3 in. with either waterbound or bituminous macadam, but as funds are not always available another method suggested itself. This method consists in spiking up the road, re-distributing the bituminous covered stone to a proper cross-section, adding as much clean ¾-in. stone as is necessary to absorb the surface tar or asphalt and then roll thoroughly with a 10-ton roller. After rolling, a seal coat of hot tarvia, hot ugite or hot asphalt is applied at a rate of ⅓ to ½ a gal. per square yard. Then 20 lb. per square yard of ½-in. and ¾-in. trap rock chips are spread and the road is again rolled with the 10-ton roller. This practically gives a light penetration road.

In Philadelphia there are several examples of this construction which are in good condition after 2½ yr. of extra heavy travel. The tonnage on one strip of roadway amounted to 570 tons per foot of maximum traveled width of road. It is the Lincoln Highway, Philadelphia-New York route. The cost at that time was about 10c. per square yard, while, at 1919 prices, the cost would be at least 15c. per square yard.

Another method which has proven successful when a surface treated road becomes badly potted consists in cleaning the road by sweeping in the usual manner, painting all depressions and filling with clean ¾-in. stone. Then apply a hot asphalt oil or hot tar of heavy consistency, to the amount of ⅓ to ½ gal. per square yard, and cover the same area with from 20 to 30 lb. of clean ¾-in. trap-rock chips, and roll thoroughly with a 10-ton roller. In the absence of ¾-in. covering, it has been shown the Delaware River washed pebbles, ¾ in. to ½ in. screen, provide an acceptable substitute. These pebbles are tough and offer considerable resistance to crushing. The cost of this repair varies from 6½c. to 11c. per square yard.

During the years 1912 to 1914 many of the older macadam roads of Philadelphia were reshaped and covered with from 2 in. to 2½ in. of bituminous concrete. This material consisted of amesite, filbertine and topeka. After the unusually heavy frosts of the winter of 1917-1918 many of these surfaces showed signs of disintegration, while others heaved badly. The remedy applied was as follows:

The cross section of the road was re-established by the aid of bituminous penetration patches, then a seal coat of asphalt cut-back (35 per cent naphtha) in the amount of ½ gal. per square yard, was applied. This was covered with 20 lb. of ½-in. trap-rock chips per square yard. In a few instances this seal coat has preserved the pavement for 2 yr., in others it was deemed advisable to surface treat after the expiration of one year.

A variation of this method consisted in applying the first coat in the form of a light (cold) tar treatment, ¼ to ⅓ gal. per square yard, with a slag or pebble covering. This was followed up in the next season with a hot tar or hot asphalt application with a pebble or slag covering. The idea of this variation was to obtain greater penetration on the first treatment. To date both methods have shown good results, but no decided superiority has become evident, with the exception that in the latter method the surface treated is more plastic.

In conducting this work only standard road equipment was used, such as pressure distributors, gravel spreaders, a 10-ton, 3-wheel roller, well equipped with sharp spikes, a grader and, in some cases, a 100-gal. stone and tar heater, together with shovels, forks and picks. Usually a foreman with 12 men constituted the working force. The rate of speed is entirely dependent upon the condition of the road and varies from 1,500 to 2,500 linear feet on a road 18 ft. wide.

Results of State Supervision of Filters

The beneficial results from technical local supervision of filtration plants and state supervisory control cannot be definitely expressed, but certain features were cited by W. H. Dittoe at the recent meeting of the American Public Health Association.

1. Under such operating conditions the constant production of satisfactory water is assured. This is particularly important in Ohio, where so large a percentage of the population is dependent upon purified water.

2. The total cost of plant operation and maintenance will in many instances be reduced. The greatest saving is in the cost of chemicals and frequently exceeds the salary of the superintendent.

3. The knowledge gained from close study of operation of water purification plants throughout the State has enabled the department to give helpful advice to municipalities and their engineers when engaged in projects.

4. The system including local technical supervision with state supervisory control has furnished a medium for the interchange of information.

Experience With Insect Larvae in Decreasing Canal Capacity

LARVÆ of insects at times attach themselves to the concrete flumes and concrete lining of irrigation canals in such quantities as to increase the friction to a point where the carrying capacity is reduced materially. In 1918 the flumes carrying the main supply of water from the Milner Dam on the Snake River, Idaho, to the project of the North Side Twin Falls Land & Water Co., were infested to such an extent that the capacity was reduced about 10 per cent. The water had to be shut off for two days and the larvæ removed with slip scrapers, fresnos and dump wagons. In earlier years the fluctuation of the carrying capacity had been noted and charged to variation in the rating, leaks, temperature, etc. A similar experience in 1919 on the Tieton Canal of the Yakima Project in Washington is reported by R. K. Tiffany, project manager in the *Reclamation Record* for February, from which the following notes are abstracted:

The larvæ are found atached to the inner wall of the concrete-lined canal, where the velocity is 9 to 10 ft. per second. The surface is quite smooth, as it was cast in metal forms. The temperature of the water ranges from 45 deg. to 70 deg. F.

An inspection of the canal at spillway 1 during August showed no water grass or algæ present, but the sides of the section were thickly infested with small brownish-colored worms, slightly less than $\frac{1}{16}$ in. thick and varying from $\frac{3}{4}$ to $\frac{1}{2}$ in. in length. These worms gained lodgment in the small pores in the concrete, and upon gradually reducing the quantity of water flowing, they followed down the sides to the lower level. When the canal was suddenly shut down they emerged from the pores and crawled over the concrete. Apparently the full colony survived a two-day shut-down about the middle of September, but no traces were to be found two weeks after the water was shut off on Sept. 30.

Upon making an examination of this part of the canal two days after the close of the irrigation season, a larger species was found with the others in the pools in the bottom. The larger variety averaged about $\frac{1}{2}$ in. in length and from $\frac{3}{32}$ to $\frac{1}{8}$ in. in thickness, and were brown and greenish-brown in color.

Small nests or cocoons of these two varieties of insects were removed from the sides of the concrete about the middle of October. The smaller cocoons were scattered thickly over the sides of the section with openings directed downstream; the larger cocoons were less frequent, opened against the current, and were found in the shaded areas and under Steeple tunnel. It required some care to remove the smaller cocoons with a pocketknife. The larger variety were readily dislodged with the fingers.

L. O. Howard, chief of the Bureau of Entomology, U. S. Department of Agriculture, states that the forms are cases of the caddis fly and the cocoons and pupa shells of one of the black flies of the Simulium. He suggests no other method of removal than scraping them off with a hoe or some other instrument.

Ralph H. Smith, associate entomologist of the University of Idaho, suggested to R. E. Shepherd, manager of the North Side Twin Falls Land & Water Co., that a heavy cotton rope might be soaked in kerosene and hung along the sides of the concrete retaining walls so as just to touch the surface of the water. This would keep a film of oil along the moistened surfaces of the walls where the water splashes up, and might possibly prevent the females from laying their eggs. In laying their eggs the female flies light upon the concrete wall and move down to a point where they can dip the posterior end of the abdomen in the water, or at least in the surface film of water on the walls. If a film of kerosene were present the end of the female's abdomen would get a coat of kerosene, and although it would be ever so small an amount, it would be sufficient to kill her. Mr. Smith did not know of the oiled rope ever being tried for such purposes, and so it would be a matter of experiment to find how long one oiling of a rope would last. He suggested that crude oil might do the work just as effectively as kerosene.

J. G. Needham, limnologist of Cornell University, suggested painting the walls with some asphaltum mixture as a repellant which would prevent deposition of the eggs. The suggestions were received too late to be put into effect by Mr. Shepherd, and in 1919 the larvæ were not present in sufficient numbers to cause trouble.

Sign Boards for French Highways

WAR has had its impress upon certain governmental bureaus of the French Republic, as is indicated in a recent article by Louis Dreyfus, American Consul at Paris, for, finding that road signs adopted by the French and Allied armies during the war were so efficacious for the traveler by automobile, the French Ministry of Public Works has decided to carry out the ideas developed through the war traffic, by erecting danger signals and indicating noteworthy places, and by denoting the route to be followed as regards direction and distances.

According to a circular on this subject emanating from the Ministry of Public Works and directed to the prefects of the departments, the names of villages must be conspicuously posted; the inscription must be readily legible and placed on a post, or preferably on a wall or building, as nearly at right angles to the road as possible, and on its right. Only the name of the locality should appear on the sign. Efforts are also to be made to have the name of the town placed on the city hall, railway station, postoffice, and other public buildings.

As to danger signals, the four signals adopted by the International Conference relating to automobile traffic will be the only ones used. They are the signs for inclines, turns, road crossings and railroad crossings. These are to be posted about 275 yd. before the place to be designated, unless special conditions should require otherwise. They are to be perpendicular to the road, and on the right of the direction followed.

Signs indicating direction are to be situated at the entrance or exit of places, as well as at branches or crossings of importance. There is to be a different sign board for each direction, containing only the name of the first place in the direction one is proceeding, and the name of the first town of importance toward which one is traveling. The latter name will be identical on successive posts until the town in question is reached. Distances will be recorded in kilometers beside the name of town. The inscriptions are to be headed with an arrow and abbreviation indicating the class of road. All signs are to be placed so that they will be within the

radius of the lights on vehicles. They are to be 6 ft. 6 in. above the level of the road if they are in a place near which there is pedestrian traffic, and 6 ft. 3 in. high at the most if they are on a wall. The placing of signs on walls or buildings is recommended.

Inscriptions are to be white on a dark blue background, with the lettering 6 in. in height. Numerals will be a little smaller than letters. Iron, varnished sheet iron, or wooden signs can be used. Enamel signs are not recommended as they deteriorate too easily and are difficult to repair. On the other hand, wooden signs and posts which are prepared with care can be preserved for a long time. Maintenance of the signs is to be looked after so that inscriptions are always legible. It is planned to have the roads of France completely equipped with these signs by the end of 1921, at the latest.

Excess Motor Equipment Alloted to States for Highway Work

STATE highway officials again are expressing disappointment at their inability to secure certain classes of materials for roadbuilding purposes from the War Department. It had been expected that the action of Congress in expressly directing the Secretary of War to turn over surplus materials suitable for road-building purposes would accelerate delivery. Previously, legislation left the transfer of materials to the discretion of the Secretary of War.

One of the results of the mandatory statute has been the withdrawal of much of the needed material from the surplus list. Steam shovels, cranes, mobile machine repair shops, and industrial railway steel, are items than can be used to great advantage at a number of points but the greatest difficulty is being experienced in securing this property. The War Department is said to have very imperfect inventories. Even when agents of the Bureau of Public Roads locate the material, it generally means a long fight to secure its transfer. The latest statement from the U. S. Bureau of Public Roads concerning allotments and deliveries of motor vehicles to the states is given herewith.

		Allotments			Total Vehicles allotted	Total Motor Vehicles delivered to April 1, 1920	Percentage delivered April 1, 1920
		Trucks	Fords	Autos			
1	Alabama	432	53	11	496	340	69
2	Arizona	282	35	6	323	277	86
3	Arkansas	343	42	8	393	326	83
4	California	622	77	15	714	579	81
5	Colorado	358	44	9	411	344	84
6	Connecticut	124	15	4	143	125	87
7	Delaware	34	4	4	42	42	100
8	Florida	236	29	6	271	200	74
9	Georgia	553	68	14	635	514	81
10	Idaho	251	31	6	288	230	80
11	Illinois	898	110	22	1030	892	87
12	Indiana	556	68	14	638	505	79
13	Iowa	595	73	15	683	517	76
14	Kansas	593	73	15	681	538	79
15	Kentucky	400	49	10	459	368	80
16	Louisiana	280	34	7	321	287	89
17	Maine	196	24	5	225	182	81
18	Maryland	181	22	4	207	137	66
19	Massachusetts	303	37	7	347	208	60
20	Michigan	596	73	15	684	543	79
21	Minnesota	584	72	14	670	549	82
22	Mississippi	366	45	9	420	307	73
23	Missouri	697	86	17	800	614	77
24	Montana	413	50	10	473	370	78
25	Nebraska	440	54	11	505	387	77
26	Nevada	265	33	7	305	240	79
27	New Hampshire	83	11	2	96	88	92
28	New Jersey	245	30	10	285	273	96
29	New Mexico	331	40	8	379	315	83
30	New York	1021	126	25	1172	843	72
31	North Carolina	470	58	12	540	447	83
32	North Dakota	319	39	8	366	287	78
33	Ohio	761	94	19	874	762	87
34	Oklahoma	476	58	12	546	510	93
35	Oregon	326	40	8	374	295	79
36	Pennsylvania	942	116	23	1081	776	72
37	Rhode Island	48	6	1	55	52	95
38	South Carolina	296	36	8	340	281	83
39	South Dakota	333	41	9	383	278	73
40	Tennessee	462	57	11	530	461	87
41	Texas	1199	148	30	1377	1045	76
42	Utah	237	29	6	272	225	83
43	Vermont	95	12	3	110	85	77
44	Virginia	406	50	10	466	399	85
45	Washington	298	36	7	341	263	77
46	West Virginia	217	27	5	249	195	79
47	Wisconsin	521	64	13	598	399	67
48	Wyoming	252	31	7	290	232	80
49	Dept. of Agriculture	1129	287	55	1471	799	54
Totals		21,065	2737	557	24,359	18,933	78

Test Shows Actual Live Load on School Room Floor

To ascertain definitely what live load actually comes upon an ordinary class room floor, E. H. Enger, architectural engineer of the Bureau of Buildings, Minneapolis Board of Education, recently made test at South High School, Minneapolis. As a result of the test the municipal building department reduced the standard required by 25 lb. per square foot. Before that time the Board of Education was compelled to provide for 100 lb. live load per square foot.

In a room 24 ft. 5 in. x 32 ft. (781.3 sq.ft.), 258 pupils were placed. This gave each pupil 3.03 sq.ft. of floor area, including space taken up by desks. The room was crowded, two pupils in each seat, aisles full and space in front, rear and sides of room filled. The room normally held 48 pupils and one teacher.

The pupils were weighed one at a time as they filed out of the room. The result was:

Desks, 48 at 55 lb.	2,640 lb.
One desk at 87 lb.	87 lb.
Pupils, total weight	29,848 lb.
Total weight	32,575 lb.

This makes the total live load per square foot, 41.7 lb. Average weight per pupil was 115.6 lb. Under normal conditions the result would have been:

48 pupils at 115.6 lb.	5,550 lb.
48 desks at 55 lb.	2,640 lb.
1 desk at 87 lb.	87 lb.
1 teacher at 175 lb.	175 lb.
Total weight	8,452 lb.

This gives a load per square foot of 10.83 lb. Had the room been filled with adults at 150 pounds average, as in night school work:

48 persons at 150 lb.	7,350 lb.
48 desks at 55 lb. each	2,640 lb.
1 desk at 87 lb.	87 lb.
Total weight	10,077 lb.

This gives a load per square foot of 12.9 lb.

Good Concrete Watertight Under 35-Ft. Head

Tests of concrete tanks for watertightness have recently been made by the United States Bureau of Standards. These tanks were made of ordinary 1 : 2 : 4 concrete with only the usual precautions for good material and mixing and placing. For a while the loss increased slightly with time, but after 150 days it was found that the day loss curve took the form of a straight line showing daily loss had become constant. This loss, however, was so low that the outside of the tanks were dust dry. It is the conclusion, therefore, of the Bureau that 1:2:4 concrete in this case was sufficiently waterproof for this head.

Swamp Drained by Conduits Under Floor of Culvert

By R. C. Hardman
Formerly Superintendent Division of Municipal Engineering, The Panama Canal

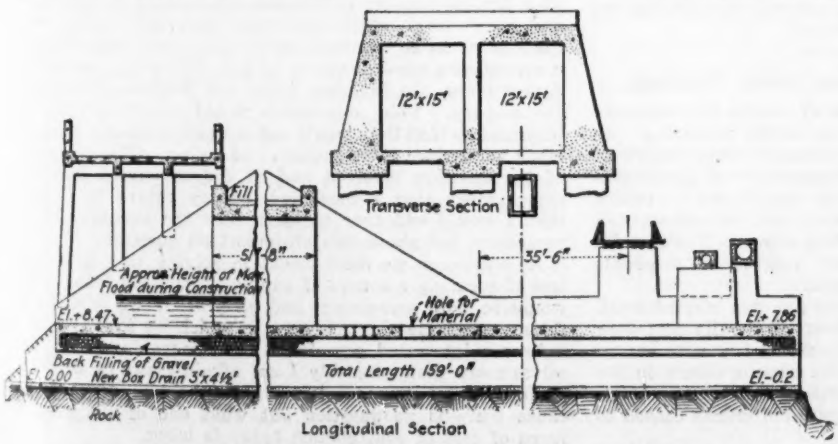
TO ELIMINATE an anopheles-mosquito-breeding swamp resulting from the very flat grades of the Cardenas River in the Panama Canal Zone the bed of the stream was lowered 8½ ft. by means of a 3 x 4½ ft. reinforced-concrete box drain under the floor of an existing culvert. The stream was carried by the culvert, which has a concrete bottom at El. 8.47, which is higher than the old stream bed. As a consequence the stream backed up and formed the swamp. The culvert discharged the stream with a drop of about 15 ft., or to about El. 7. By the construction of the box drain the stream has been brought to approximately its former level.

The culvert was originally built to carry the Panama Railroad and had a width at the top of 37 ft. 6 in., but was later widened to 51 ft. 8 in. The floor was likewise extended at the lower end to carry the stream under an old highway bridge and two pipeline trestles. More recently a reinforced-concrete highway bridge was constructed upon the upper wing walls as shown in the drawing. The floor of the culvert and the apron extension has a total length of 149 ft.; that part of the floor under the culvert proper is reinforced by old rails on 2-ft. centers transversely and on 4-ft. centers longitudinally; the apron floor is not reinforced. Consequently in the construction of the drain the portion under the old culvert was done by tunnelling, the material being removed through four holes in the floor. The portion under the apron was by open cut.

As the work was all done in the rainy season when high floods are to be expected, no attempt was made to exclude from the work any but the normal stream flow and high tides, which reach a maximum at El. 11.2. This was accomplished by small cofferdams built around each end of the culvert barrel under which the drain was built. The other barrel of the culvert was separated from the first by temporary low bulkheads and by means of three lines of 20-in. dredge pipe the normal flow of the stream was carried. Floods, which reached a maximum elevation of about 12.5 during the work, handicapped the work somewhat but none was disastrous. Cofferdams were kept dry by a steam pump having a 6-in. suction and discharge.

The excavation, which was mostly of stiff blue clay, presented no unusual difficulties. Rock, varying from nothing to about 2 ft. was encountered practically the full length of the work, the lower end only of the drain not being founded on rock. Backfilling between the top of the drain and the bottom of the culvert floor was made with gravel and sand well rammed in.

The work was carried out by the forces of the Division of Municipal Engineering, under George W. Green, acting superintendent, and W. E. Maxon, who served as general foreman.



LONGITUDINAL AND CROSS-SECTIONS OF DRAIN 159 FEET LONG UNDER CULVERT FLOOR AND APRON

Interest in Irrigation Rapidly Increasing in California

During 1919 the number of applications for the formation of Irrigation Districts in California was twice what it has been in any previous twelve months and the area involved was considerably more than double any preceding record. This refers to new districts and does not include applications for extensions. It is notable that among last year's applications there are fewer than heretofore of the sort which are of doubtful stability or which state officials must refuse to approve.

Among the new districts this last year have been some particularly large units. For example, the Madera and Merced districts comprise 350,000 and 173,000 acres respectively. For the former there is proposed a dam 382 ft. high on the San Joaquin River. Among the other projects now under consideration are the Pine Flat District on Kings River with a dam almost as high as that just mentioned and another large project on the Kern River. A notable feature of these proposed districts, particularly the large ones, is that they are receiving careful engineering attention in the preliminary stages.

The causes of the increased activity in the formation of Irrigation Districts in the past year are ascribed to the fact that there has not been much extension of irrigated areas during the preceding years and also because the three successive dry years which California has suffered have directed attention toward irrigation; that is, in districts where dry farming was previously satisfactory the demand is now for irrigated areas. It is notable that among the new projects those on which the water has to be pumped are in a small minority; the preference is for gravity systems. practically all of the petitions received during the last year apply for the formation of districts under the amended Wright Act. This is more properly known as the California Irrigation District Act. There is a more recent act known as the California Irrigation Act which is said to have certain advantages over the Wright Act, but the new act has not yet been tested out legally and there seems to be unanimous preference for charters whose validity has been fully proved.

LETTERS TO THE EDITOR

Rating of State Sanitary Control of Public Water Supplies

Sir—There has come to the attention of the Bureau of the Public Health Service an article in *Engineering News Record*, Jan. 1, 1920, p. 44, entitled "Rating of State Sanitary Control of Public Water Supplies," accompanied by a chart and recapitulation. The text of this article attributes the data to the Public Health Service.

A review of the records shows that the publication of this article occurred without the knowledge or consent of the Bureau and further that the Public Health Service did not prepare data such as the article is represented as having been compiled from.

In view of these circumstances it is requested that you retract your statement of the averred source of the data upon which the article was based and make suitable explanation to correct the widespread misapprehension its appearance caused, particularly on the part of the divisions of sanitary engineering of the various states. This latter result of the appearance of the article is especially unfortunate and opprobrious in view of the increasingly friendly relations existing between the Service and the various state agencies exercising control of water supplies.

Washington, D. C. H. S. CUMMING,
Surgeon-General, United States Public Health Service.

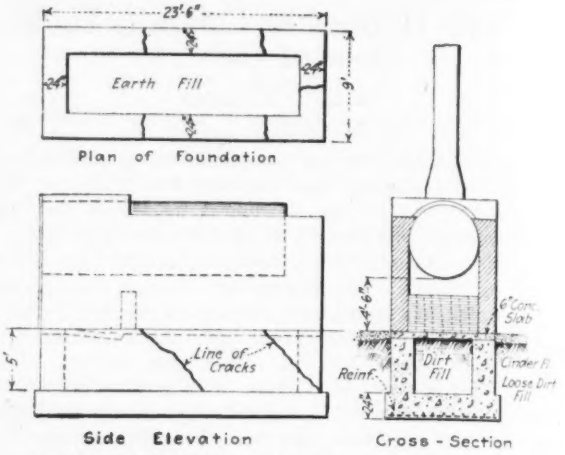
[The map and rating data in question but not the accompanying text were sent to *Engineering News-Record* by a long trusted friend with the statement that they had been copied from a copy of a chart made up by persons connected with the United States Public Health Service. Our correspondent stated that he did not know whether the Service desired to have the data "published, but you might get permission from them if you desire." Through an oversight that we very much regret the suggestion was overlooked and the data were reproduced without consulting the Public Health Service. Except for the general title to the article and ten lines of text, all based upon the material that came to us, *Engineering News-Record* made no compilation or deductions. By a slip of the pen, Michigan was substituted for Massachusetts in the text as being one of three states that stood highest in the rating table but the table itself showed Michigan second in the list. We had no reason to suppose that the data were confidential nor that they were not authentic. The blueprint showing the data we reproduced bore a title distinctly stating that the "rating" was made by the United States Public Health Service and bore the date "1919." We are informed that there are a considerable number of discrepancies between the original data compiled by persons connected with the United States Public Health Service and those shown on the map and rating table published in our issue of Jan. 1, but a careful checking discloses no error in reproducing the map and table received by us.—EDITOR.]

Curious Cracks in Concrete Boiler Footings

Sir—An interesting development of cracks in a concrete boiler footing seems to the writer worth recording. In the early fall of 1919 the Maintenance Department of McCook Aviation Field, built a foundation of the dimensions shown in the accompanying sketch for a return tubular boiler. The foundation was built on gravel soil, of 1:2:4 concrete with walls of sizes shown. The dirt fill inside the walls was put in and watered to a puddle shortly before the top slab was poured.

After the boiler was installed and fire was started small cracks began to appear on the two side walls and rear wall as shown. From these cracks steam began to escape with considerable force. The cracks became larger in the course of a day or two until they were about ¾-in. in width. By this time escape of steam stopped and cracks ceased to open further.

Upon investigation by digging to the footing the cracks



DETAILS OF BOILER FOOTING IN WHICH CRACKS OCCURRED

were found to stop at the footing, proving that no settlement had taken place.

The writer's opinion is that the wet earth fill, upon being heated, produced steam enough to make sufficient pressure to crack the concrete walls. The cracking of the walls in more than one place was probably caused by walls of mud (caused by unequal settlement of dirt when watered) forming several pockets or compartments, thus confining the steam pressure to a small wall surface.

H. E. MILLER,
McCook Field Dayton, Ohio. Architecture Engineer.

Shall Chinese Be Imported To Relieve Unskilled Labor Shortage?

Sir—I have just returned from an extensive trip covering the entire West where I found from the time I left Chicago until I reached the Pacific Coast, thence from the Mexican to the Canadian borders, that the main topic of conversation, whether it was banker, farmer, merchant or engineer with whom I conversed, was the shortage of unskilled labor. This because the same was not only affecting the production of their farms and their industries but because it was also seriously handicapping many large engineering projects whose furtherance was being stunted on account of the lack of economical labor as represented by *the pick and the shovel and wheelbarrow man.*

I also found that some of the thinking people of the West were endeavoring to solve the question and have started active work in sounding sentiment as regards the modifying of the Exclusion Act so as to permit the importation of a limited number of Chinese laborers to do the menial and rough work which our white labor will no longer do. Such labor to be admitted under the direct supervision of a commission representative of our different governmental departments, the farming, labor and business interests of the country. This commission would supervise their employment so that they would not compete with our American labor nor reduce their standard of living. The importance of the question involved and of the movement impressed me so much that I concluded, on my return to Chicago, that I would endeavor to learn how the members of our profession feel about this all-important question.

As engineers we must assist in solving this vital problem of securing a source of supply of common labor, which would be both economical and efficient, if we wish to see the many engineering projects, in which we are directly or indirectly interested, completed. Unless we do interest ourselves more than passively I am afraid many of the large projects under consideration will be held in abeyance because there is no question but what one of the greatest items of cost of construction today is labor.

As city engineer of Chicago for twenty-two years, my

experiences have been many as to how the increased labor costs have affected construction. Realizing what the securing of economical labor means to the future of our profession, because of the effort the present abnormal labor conditions are having on capital seeking new development projects, I concluded that it is timely to make a survey and I am desirous of securing opinions as to the importation of Chinese labor under the above-mentioned conditions.

The eyes of the world are upon America. Europe has been drained of its manhood. Continental industry has been crippled beyond hope of immediate reparation and the foodless populations of devastated countries now look to us for salvation. Shall we sit idly by and permit antiquated and perverted notions of "economic necessity" to stultify our efforts? Or shall we assert the cause of righteousness and, recognizing the needs of the hour, pronounce to the world that America is prepared to continue the pace in the race for progress already set by tireless workers of reconstruction?

As the law of supply and demand governs at all times and with the demand here and not sufficient supply available, I believe it is up to us to do something.

JOHN ERICSON,
Consulting Engineer, Department of Public Works, Chicago.

Chicago.

"Prohibition and the Foreign Born"

Sir—I am astonished at a policy that permitted you to print such an editorial as the one found in the *News-Record* of April 15 headed "Prohibition and the Foreign Born." It is true that most of the space occupied by this editorial is in quotes, but the last paragraph so adequately expresses the editor's agreement with the sentiments that the paper has seen fit to quote, that there can be little doubt that they represent the editorial attitude.

In the first place, the subject impresses me as one that does not properly belong in the technical press, and I think you will find that most engineers will agree with me on that point. I cannot believe that *Engineering News-Record* has strengthened its position among engineers by taking up this question, whatever may be the personal desires or opinions of the writer of that editorial.

There are but few people who believe that the moral question was strong enough to add the eighteenth amendment to our constitution. You will find that the general consensus of opinion of thinking men, who have the facts at hand, is that the economic argument, and not the moral argument, was what finally put prohibition across. Your last paragraph attempts to justify the editorial on the ground that you are discussing an economic peril. It may or may not be true that you have hit upon one of the economic ills of prohibition. There probably are more of them. But engineers, above all men, are supposed to present full facts, suppressing none, before drawing conclusions. Possibly you have presented a fact that appears to support a contention you desire to make. But you have presented such partial data, and it is so apparent that much has been suppressed, that it appears most untechnical for you to attempt in this manner to arouse us to the idea that there is an economic peril. Even if it were granted that the one thing you quote is an economic evil (a concession I am not prepared to make) it is the net economic effect we want to know about.

It is inconceivable to me that a paper of such high standing as the *News-Record* should quote sucsh out-and-out liquor propaganda as the statement, "under prohibition the workers are restless and discontented," and then back up such a statement with its editorial comment. Labor is equally, if not more, restless in countries of the world where there is no prohibition. The effects of the labor troubles in England have been more far-reaching than any trouble we have had; and England has not prohibition. I have always thought that such propaganda was spread for the benefit of men who could not reason or think for themselves. I certainly did not expect to find a paper which I have always held in high esteem, spreading such illogical bunk.

Let me tell you that the prohibition amendment was not added to our constitution by "those prohibitionists who regard the taking of a drop of liquor as a deadly sin," as you appear to believe. It was put there by men vitally and actively interested in the economic welfare of this country, the same economic welfare which you say is in peril, and it is being supported there by these same men and by others of their type, in vastly increasing numbers, who are coming to realize the asset that it is to business, industry, and the general development and economic advancement of the country. If "Ye Scribe" believes that the moral question was the argument that wrote the amendment on our books he must be a Rip Van Winkle, just returning from the mountains.

EDGAR DOW GILMAN,
Cincinnati, Ohio. U. S. Engineer's Office.

[With Mr. Gilman's contention that the editorial in question "does not properly belong in the technical press" we can not agree. The big problem in the construction field today is to secure common labor. It would seem that, especially in the interests of contractors, discussion of any phase of the labor situation has a distinct place in an engineering paper. The editorial made no pretence of presenting "full facts," nor did it draw conclusions tending to "arouse us to the idea that there is an economic peril." It did advocate a calm inquiry into the effect of prohibition on immigration and into the advisability of altering the amendment. Mr. Gilman wants facts. Surely such an inquiry as is suggested is the only way of obtaining them.—EDITOR.]

A New Society of Interest to Engineers

Sir—The Secretary of the American Meteorological Society asked the writer to communicate to *Engineering News-Record* something regarding the features of the work of this new organization.

The Society, organized at St. Louis, December, 1919, includes in its objects matters of interest to various classes of engineers. As stated in the Constitution: "The objects of this Society are: The advancement and diffusion of knowledge of meteorology, including climatology, and the development of its application to public health, agriculture, engineering, transportation by land and inland waterways, navigation of the air and oceans, and other forms of industry and commerce."

The Society is intended to be largely a working organization, and to that end various special committees have been appointed, having charge of investigations and promotions of meteorological work along different lines. Of most interest to engineers are:

The Committee on Agricultural Meteorology, of which J. Warren Smith, U. S. Weather Bureau, Washington, D. C., is chairman. This committee will cover work in many respects closely related to that of Agricultural Engineers interested in irrigation and drainage.

Major-General C. T. Menoher, Air Service, Washington, D. C., is chairman of the Aeronautical Committee.

The Committee on Engineering Meteorology, of which the writer is chairman, includes several engineers among its membership. This committee will undertake at once an active study of the needs for additional rainfall stations in the United States, and all engineers interested in having increased rainfall records or other meteorological data are requested to communicate with the chairman of the committee. Co-operation with engineers and contractors is also desired in devising means for making weather and flood forecasts especially useful in river improvement and other construction work.

Persons actively interested in meteorology, or the use and application of meteorologic data, may become members. Fellows are elected by the Council, requirements for fellowship being of the same nature as those for membership in engineering societies. The fixed annual dues for members and fellows are $1. Higher grades of membership and fellowship with increased annual dues are also provided for.

Voorheesville, N. Y. ROBERT E. HORTON.

HINTS FOR THE CONTRACTOR

Friction Heads for Water Supply for Highway Construction

By R. E. S. GEARE
General Sales Manager, T. L. Smith Co., Chicago

FAILURE of water supply because of insufficient pump and pipe line capacity occurs frequently in highway construction operations. In the majority of instances the cause is neglect of friction head. This resistance per 100 ft. of pipe for different volumes of flow is given in the accompanying table.

With this table the calculation of head and of horsepower is a simple operation. It is desired, for example, to deliver 100 gal. per min. to an elevation of 100 ft. through 200 ft. of 2-in. pipe with two elbows and one valve in the line; what will be the head? With 100 ft. (elevation) plus 43.5 (friction in 200 ft. of 2-in. pipe, which is double the friction in 100 ft. of 2-in. pipe as given in the table) plus 3 (friction in elbows), plus 1.7 (friction in one valve) we have: $100 + 43.5 + 3 + 1.7 = 1.48.2$ ft., total head.

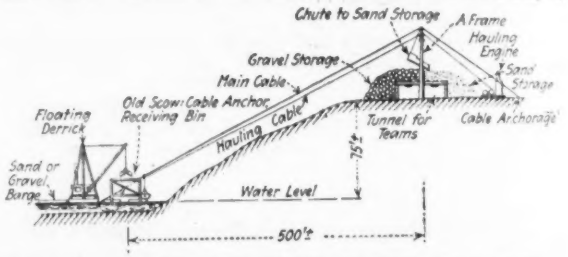
With 100 (gallons per minute) multiplied by 8.33 (weight in pounds of one gallon of water) multiplied by 148.2 (total head in feet) divided by 33,000 (33,000 lb. elevated 1 ft. in 1 min. is one horsepower) we have: $(100 \times 8.33 \times 148.2) \div 33{,}000 = 3.74$ theoretical horsepower. At 60 per cent pump efficiency we have: $3.74 \div 0.60 = 6.2$ actual horsepower.

Once the capacity of pump and pipe line is correctly determined a few simple precautions will prevent the majority of pumping troubles experienced in highway construction. 1. Look the pump over for mechanical defects at least once a week. A new bolt or nut may avert a costly shutdown later. 2. Oil the pump regularly. 3. Be sure that the weight of the discharge line is not borne by the pump; brace the line or support it firmly. 4. With a force pump, place a foot valve, with drainer, in the submerged end of the suction line and a valve in the discharge line. 5. With a centrifugal pump, a hand or steam primer should be provided and connected to the top priming hole in the casing. Fill the casing with water *before* starting the pump.

Plant For Sand and Gravel Storage

By GEORGE W. MCALPIN
Point Pleasant, W. Va.

UNLOADING Ohio River sand and gravel from barges and storing them at the top of a bank so as to be accessible to teams and trucks, is successfully handled by the plant shown in the accompanying sketch. This plant was designed and installed by the Western Rivers Co., Point Pleasant, W. Va. Sand and gravel have been unloaded and stored at the rate of 50 cu.yd. or more per hour. An old dump scow, sunk in the river to a chosen point, just below mean water level, furnished anchorage for the outer end of a cable-way rig, and also supported a loading hopper. The other end of the main cable was carried over a simple A-frame at the top of the slope, and anchored to a dead man. Sand and gravel, transferred from barges to the hopper by a floating derrick passed into a bucket, operating on the cable-way with a single hauling line and no hoisting, or main-fall line. The bucket was brought to the top of the slope and dumped by a small two-drum hoist. Upon reaching the frame the bucket engaged the end of a short chute, placed between the legs of the frame, and discharged directly into the storage pile. To dump into the gravel storage a trip line was attached to the bucket to overturn it at the desired point. The bucket returned to the foot of the slope by gravity. Tunnels, through storage piles, fitted with bin gates, permitted ready loading of trucks and wagons.



PLANT UNLOADS AND STORES 50 CU.YD. PER HOUR

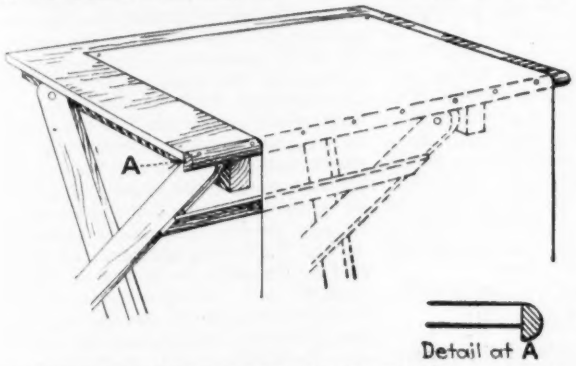
FRICTION HEADS AT GIVEN RATES OF DISCHARGES IN CLEAN WROUGHT IRON PIPE (INSIDE DIAMETER) FOR EACH 100 FT. OF LENGTH

U.S. Gal. Per Minute	U.S. Gal. Per 24 Hours	¾-In. Pipe		1 In. Pipe		1¼ In. Pipe		1½ In. Pipe		2 In. Pipe		2½ In. Pipe		3 In. Pipe	
		Friction hd		Friction hd		Friction hd		Friction hd		Friction hd		Friction hd		Friction hd	
		Feet	Lbs.	Feet	Lbs.	Feet	Lbs.	Feet	Lbs.	Feet	Lbs.	Feet	Lbs.	Feet	Lbs.
5	7200	7.59	3.30	1.93	.84	.71	.31	.27	.12	.....	.....	.....	.....	.....	..
10	14400	29.90	13.00	10.26	3.16	2.41	1.05	1.08	.47	.....	.....	.....	.....	.....	
15	21600	66.01	28.70	16.05	6.98	5.47	2.38	2.23	.97	.....	.....	.....	.....	.....	
20	28800	115.92	50.40	28.29	12.30	9.36	4.07	3.81	1.66	.....	.....	.....	.....	.....	..
25	36000	.....	.....	43.70	19.00	14.72	6.40	5.02	2.62	1.18	.51	.....	.....	.....	.....
30	43200	.....	.....	63.25	27.50	21.04	9.15	8.62	3.75	2.09	.91	.....	.....	.....	.....
35	50400	.....	.....	85.10	37.00	28.52	12.40	11.61	5.05	2.76	1.20	.....	.....	.....	.....
40	57600	.....	.....	110.40	48.00	37.03	16.10	14.99	6.52	3.68	1.60	1.19	.52	.....	.....
45	64800	.....	.....	.....	.....	46.46	20.20	18.74	8.15	4.60	2.00	1.49	.65	.....	.....
50	72000	.....	.....	.....	.....	57.27	24.90	23.00	10.00	5.61	2.44	1.85	.81	.80	.35
75	108000	.....	.....	.....	.....	129.00	56.10	51.52	22.40	12.23	5.32	4.14	1.80	1.70	.74
100	144000	.....	.....	.....	.....	.....	.....	89.70	39.00	21.75	9.46	7.36	3.20	3.01	1.31
125	180000	.....	.....	.....	.....	.....	.....	.....	.....	34.27	14.90	11.24	4.89	4.57	1.99
150	216000	.....	.....	.....	.....	.....	.....	.....	.....	48.76	21.20	16.10	7.00	6.55	2.85
175	252000	.....	.....	.....	.....	.....	.....	.....	.....	64.63	28.10	21.75	9.46	8.85	3.85
200	288000	.....	.....	.....	.....	.....	.....	.....	.....	86.25	37.50	28.68	12.47	11.54	5.02
250	360000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	45.21	19.66	17.84	7.76
300	432000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	64.53	28.06	25.76	11.20
350	504000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	34.96	15.20
400	576000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	44.85	19.50
450	648000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	57.50	25.00
500	720000	.....	..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	70.84	30.80

Half-Round Strip Protects Tracings From Harmful Creases

By C. NYE, New York City

MANY a large paper drawing or tracing has been practically ruined by pressure against it while overhanging the sharp edge of a drafting table. The drawing shown illustrates a practical remedy. A strip of half-round moulding, obtainable at carpenter shops,



DRAWING BOARD FITTED WITH HALF ROUND MOULDING

is secured to the edge of the board by means of small wood screws, set into the drawing board at an angle. The drawing will then hang smoothly over the edge and one may lean against it without fear of leaving a fold in the drawing. The board is not impaired and the strip can be removed at will. A strip with a diameter greater than the thickness of the board is recommended in order to give the drawing a flatter arc upon which to rest.

Practical Points in Constructing Hydraulic Fill Dams

The following summary of points to be observed in the construction of hydraulic fill dams is given by Allen Hazen, consulting engineer, New York City, in a paper, "Hydraulic Fill Dams," presented before the American Society of Civil Engineers May 5 and published in the April *Proceedings*, page 525:

1. It is not well to build an hydraulic-fill dam of material of which any large percentage consists of clay or of particles less than 0.01 mm. in diameter; and in general all such smaller particles may well be wasted and excluded from the dam.

2. By reducing the construction pool to a minimum, and by controlling it and the quantities of water used for sluicing, the core material may be held to a certain degree of coarseness by wasting all smaller particles. An effective size of 0.01 mm. may reasonably be sought.

3. It is desirable to study by borings the actual consolidation of the material, and to adjust the construction of the upper parts of the dam to the demonstrated condition of that which lies below.

4. Make the toes large enough to resist with an ample factor of safety the whole pressure of the core material as a liquid until there is demonstration of the solidification of the core to a point where horizontal pressure is eliminated.

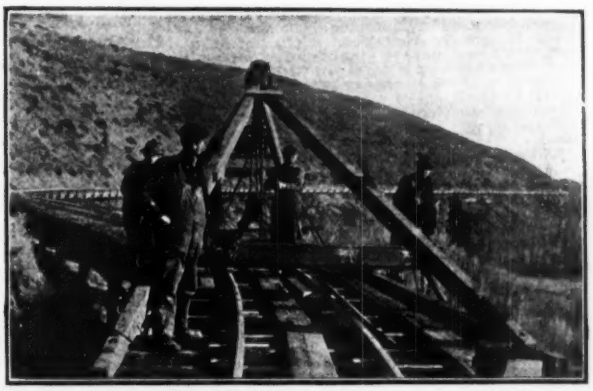
5. Increase the weight and solidity of toes by the use of rock fill, placed hydraulically or otherwise.

6. Stability is increased by compactness. It is worth while to watch voids closely, and to make every effort to hold them at a minimum. The extra weight is advantageous, but security against compression and re-arrangement with resulting temporary quicksand conditions, can be best reached in this way.

A strict application of these principles may reduce the number of hydraulic-fill dams that are built by eliminating that method of construction from consideration where the available material contains too many very small particles. It may also increase considerably the volume and cost of those that are built. It would seem, however, that following them to a logical conclusion, with such testing as can reasonably be done, will result in eliminating present uncertainties and in putting a most useful method of dam construction on a definite and safe basis.

Settled Flume Restored to Level by Derrick Traveler

A METAL flume from ¼ in. to 8 in. out of level, because of rotted trestle legs, was restored to true grade by means of the traveler shown by the accompanying view. Timber bents, spaced 16 ft., supported the flume. Sliding earth had covered the concrete pedestals and the feet of the timber posts and had caused rot which permitted settlement. To restore the grade it was first undertaken to jack up the bents, cut off the foot or two of rotted timber and splice the legs, but this process proved slow and difficult and the traveler was devised as a substitute by W. T Bowman, district engineer. The traveler spans two panels of the flume



FOUR-LEG DERRICK LIFTS LOW BENTS TO GRADE

so that its apex is directly over the intermediate bent which is being repaired. A 5-ton triplex chain block hung at the apex has its fall hitched to an 8-in. x 8-in. timber, which reaches across the flume and whose projecting ends are chained to the tops of the bent posts. By means of the traveler, the flume and its attached bent are lifted to grade and the rotted legs are cut off, spliced and reseated on the pedestals. To facilitate operation on the curves, the longitudinal struts connecting the feet of the traveler legs are hinged at the center. This traveler increased the speed of restoration about five fold. The reconstruction was on the Cascade Irrigation District canal along the Yakima River near Ellensburg, Wash., and is described in the *Highway Magazine* for April, 1920.

Caring for Activities of Juniors

In England, apparently, there is the same feeling as here that the junior members of engineering societies have not been properly taken care of. Accordingly, *The Surveyor*, London, commends the establishment of an "Assistants' Section" by the Northeastern District of the Institution of Municipal and County Engineers.

NEWS OF THE WEEK

New York, May 6, 1920

Change Basis of Representation at Organizing Conference

In its official call to engineering societies to participate in the Organizing Conference to be held in Washington, D. C., June 3 and 4, as announced in the news columns of this journal last week, the Joint Conference Committee of the four founder societies incorrectly stated the basis of delegate representation at the meeting. A uniform basis of one delegate for from 100 to 1,000 members, instead of one delegate for from 100 to 2,000 members as originally stated, will apply to both national and local societies. On this basis the American Society of Civil Engineers will name ten delegates to the Organizing Conference. The following letter, dated May 1, has been sent by the committee to secretaries of all organizations which will take part in the conference:

Through a most unfortunate oversight, which is greatly regretted, the letter of invitation sent out by the Joint Conference Committee and dated April 19, contained on p. 3 an erroneous statement with regard to the basis of representation in the Organizing Conference. The same error is found on the last page of the Credential Blank.

Will you please change the paragraph in question on p. 3 to read as follows:

Representation in Organizing Conference—As a basis of representation in the Organizing Conference, the following will be tentatively used:

Each national organization will be entitled to one delegate for 100 to 1,000 members and an additional delegate for each additional 1,000 members or major fraction thereof. Each local, state or regional organization or affiliation is entitled to one delegate for 100 to 1,000 members and an additional delegate for each 1,000 members or major fraction thereof. A local section, branch, chapter or association of a national organization will be represented through its national organization; this, however, shall not prevent its representation also as a part of a local affiliation.

Please also make a corresponding change on the last page of the Credential Blank.

Funds for Civilian Pay in Engineer Corps Held Up

The Chief of Engineers, U. S. Army, has been placed in an embarrassing position by the action of the House in rejecting, on a point of order, the appropriation carried for services of skilled draftsmen and civil engineers in connection with the engineer equipment of troops. The appropriation was carried in the Army Appropriation bill because of the failure of the Appropriations Committee to provide for these funds in the Legislative and Executive bill, which was the proper measure to carry the appropriation. The latter bill has become a law and no additions can be made to it. As a result Congress has rendered it impossible for the Chief of Engineers to carry on the activities with which he is in charge, and which are vitally necessary to the Army, but which must cease unless the necessary funds are provided for carrying on the work.

Hearings on St. Lawrence River Development Arranged

The Internationad Joint Commission has arranged a schedule of hearings in its investigation of the feasibility of deepening the St. Lawrence River to provide a route for ocean vessels from the Atlantic to the Great Lakes and to develop power along the route. The hearings begin on May 7 at North Bay, Canada, and proceed westward, stopping at all the important centers in the Canadian and American northwest, turning about the middle of June to come East again as far as Buffalo, which will be reached June 28 and 29.

Am. Soc. C. E. Has 9,441 Members

The total membership of the American Society of Civil Engineers on April 5, 1920, according to the April *Proceedings*, was 9,441.

Wisconsin Concrete Road Program Cut in Half

Although the proposed 1920 concrete road program in Wisconsin called for the construction of 400 mi., owing to "a rather acute situation relative to the cement supply" it has been found necessary to cut that mileage in half, the state being able to secure approximately only 700,000 bbl. of cement. In the quarterly progress report of the State Department of Engineering the statement is made that because of the cement situation the State Highway Commission has had to take control of the allotment of cement for concrete roads during the current year.

Although during January and February rather high bids were received on concrete roads to be constructed, it has been noted that later bids are more reasonable. More than 50 per cent of the mileage of concrete surfacing advertised has been awarded by contract or arranged for by day labor or force account work. Contracts for 63.77 mi. of concrete road have been awarded since January 1, 1920. On Federal-aid work 40 project statements, involving a total expenditure of $3,047,348, have been submitted, of which number 20 have been approved.

Wisconsin contemplates doing important work this year by day labor. The number of these day labor jobs has not yet been determined and the work and the organization not finally completed. Studies are being made of plant and equipment necessary, and it is expected that these jobs will go forward as soon as the season will permit. Every effort will be made to gain the utmost from these jobs in the way of information with respect to cost and other details of the work.

N. Y. Engineers and City Officials Discuss Salaries

With the object of bringing to the attention of responsible representatives of the city administration the facts regarding the inadequacy of the pay received by employees in the engineering service, the Municipal Engineers of the City of New York had as guests at their meeting held April 28 the Comptroller and the Civil Service Commissioner, both of whome spoke from the point of view of the employing authority after the case of the engineer in the city service had been presented by Arthur S. Tuttle, chairman of Engineering Council's Committee on Classification and Compensation; Robert Ridgway, engineer of subway construction, Transit Construction Commission; and J. Waldo Smith, chief engineer, Board of Water Supply. No action designed to relieve present conditions was taken at this session, although it was announced that the next meeting of the society this month would be devoted to open discussion of the subject of compensation.

Statistics presented by Mr. Tuttle showed that technical men in municipal service are receiving an average compensation considerably less than that secured by workers in the New York building trades who are now being paid on a scale of $9 a day. From 1915 to 1919 the average increase in pay of municipal engineers throughout the country has been only 9 per cent, the present average salary being slightly less than $2,000 per year, or less than a "living wage" for a man with family responsibilities. In urging increases for the New York engineers Mr. Tuttle also contended that the "dead wood" in the service should be cleaned out. He said that the setting up of new standards of compensation for engineer service in New York would quickly be followed by a general improvement in the status of city engineers throughout the country.

Robert Ridgway, speaking from an experience of 35 years in the engineering service of New York City and from the point of view of the man who has risen from the ranks to a position of high executive responsibility, made a forceful address, describing frankly the effect which the present scale of pay has had in lowering the morale of the city's engineering staffs and in creating an extremely large turnover of personnel—450 per cent in the case of the Transit Construction Commission in the period from 1913 to 1919. It is a short-sighted policy, Mr. Ridgway held, which fails to recognize that in the reconstruction period through which we are now passing, engineering skill is just as necessary as it was during the war. Inadequacy of pay to meet

the present high cost of living is driving many of the best men out of the municipal service. If efficient technical organizations are to be maintained, it was pointed out, the city must meet, to a degree at least, the competition for men in private work.

J. Waldo Smith scored the engineer who, rising to the position of an employer of technical men, endeavors to show a low percentage cost of engineering on his work by compressing the payroll to the smallest limits. In the city service it was his belief that the deterioration in the quality of engineers during recent months has been most marked in the higher grades. In other words the able department head is leaving municipal service to take up more profitable work elsewhere. The value of engineering work, Mr. Smith said, should not form the basis of the pay of the engineers engaged on it. A job involving a comparatively small total cost may call for high skill in design or construction while ordinary work involving a big expenditure, such as an earth removal contract, may demand only ordinary engineering planning or supervision. While pay increases in city service may be slow, said Mr. Smith, it is equally true that decreases seldom are made and there is a great degree of permanency in such positions.

Commissioner William Drennan described the Civil Service Commission as an employment agency and made a plea for co-operation by heads of engineering bureaus in the selection of men and in the elimination of the useless city employee. At least 5 per cent of the municipal employee personnel can be "shaken out" each year, Commissioner Drennan believes, with great benefit to the service. The really valuable men, he maintained, are seriously damaged by the retention in office of incompetents. Professional dignity and modesty, he stated, deterred engineers in seeking what was due them. No such conditions were noticeable in the case of policemen and firemen.

Comptroller Charles L. Craig expressed the opinion that in years past New York City had been "over-engineered." He presented some sidelights on experiences with legislation involving appropriations at the State Capitol. A significant statement was one which explained that the progress of legislation is generally in proportion to the "voting element" behind it.

Detaining Reservoir Proposed for Hopkinsville, Ky.

A detaining reservoir and channel regulation work to protect Hopkinsville, Ky., from floods in the Little River have been recommended by Norcross & Keis, consulting engineers, Atlanta, Ga. The total estimated cost is $250,000. The proposed detention reservoir is somewhat similar to the one designed and built by the Solomon-Norcross & Keis Co. for Watervliet, N. Y., which Mr. Norcross states has proved most successful.

A. A. E. Officers Nominated

The following members have been nominated for election at the sixth annual convention of the American Association of Engineers to be held in St. Louis on May 10 and 11:

For president: L. K. Sherman, president of the U. S. Housing Corporation, Washington, D. C.

For first vice-president: T. A. Evans, senior engineer of the Board of Local Improvements, Chicago; H. O. Garman, chief engineer of the Public Service Commission of Indiana, Indianapolis.

For second vice-president: J. K. Anderson, consulting engineer, Charleston, W. Va.; Paul V. Augustinus, vice-president of the Marquette Electric Engineering Co., Chicago; A. B. McDaniel, principal engineer, construction division of the Army, Washington, D. C.

Minneapolis Engineers Endorse Hoover for President

At a meeting April 21 the Engineers' Club of Minneapolis endorsed a resolution advocating the nomination of Herbert Hoover for President.

Portland Cement Production in 1919

Preliminary estimates compiled by the United States Geological Survey, indicate that the production and shipments of portland cement in 1919 increased 13 and 21 per cent, respectively, over those in 1918 and that the stocks decreased 52 per cent, so that at the end of 1919 less than 5,000,000 bbl. of portland cement was in stock at the mills. The industry was set back considerably in 1918, when war restrictions reduced the shipments from the 90,703,474 bbl. shipped in 1917 to 70,915,508 bbl., but it is now regaining its lost ground. Early in 1919 the business was even poorer than in 1918, and practically all the increase reported was made during the latter part of 1919. The increase in the value of the cement shipped in 1919 over that shipped in 1918 was about 28 per cent. The shipments of portland cement in 1919 amounted to 85,485,000 bbl. valued at $144,461,000; the production amounted to 80,287,000 bbl.; and the stocks at the mills at the end of the year amounted to 4,976,000 bbl.

One new plant produced portland cement in 1919—the Indiana Portland Cement Co., at Greencastle, Ind. The total number of plants that produced cement in 1919 was 110, and the total number of plants that shipped cement was 113. The average factory price per barrel for portland cement in bulk in individual States in 1919 ranged from $1.57 in Kansas to $2.03 in Utah. The average factory price for the whole country in 1919 was $1.69, an increase of only 6 per cent over 1918.

The exports of hydraulic cement from the United States in 1919 amounted to 2,463,689 bbl. valued at $7,516,019, or $3.05 per bbl., increases of about 9.27 and 16 per cent, respectively, over 1918.

To Elevate Indianapolis Belt Line

The city engineer of Indianapolis, Ind., has been directed by the Board of Public Works to prepare plans and specifications for elevating the freight belt line of the Indianapolis Union Ry. from W. 10th St. to Kentucky Ave. The proposed work will extend 3¼ mi., crossing ten streets and involving the separation of grades at three railway crossings. It may necessitate the relocation of the Belt Line shops. An approximate estimate of cost is $2,000,000. As several railway junctions and connections are affected, considerable time will be required to secure plans that will meet with universal approval and it is not probable that any construction work can be done for two or three years.

One-Third Iowa Highway Program Under Contract

With the assistance of Illinois, Wisconsin and Minnesota contractors more than 100 of the 300 mi. of hard surfacing scheduled for construction during 1920 by the Iowa State Highway Commission had been let by the end of March. Early in March engineers of the commission estimated that possibly the state might get 50 mi. of paving under contract for the season. However, owing to a let-up in highway construction in Illinois, contractors in that state wrote asking for information concerning certain Iowa lettings. The result was that most of the contracts let during February and March were let to Illinois, Wisconsin and Minnesota contractors.

Of the 106.23 mi. of hard surface highways already under contract 84.53 mi. will be of concrete and 21.7 mi. of brick. Contract prices on concrete range from $3.59 to $4.37 a sq.yd.; and on brick from $5.43 to $5.93 per sq.yd. The total amount of grading and excavation contracted for is 683,427 cu.yd. at prices ranging from 54c. to $1.48 per cu.yd. Eleven miles of graveling have also been put under contract at 90c. per sq.yd.

It is hoped that at least 150 mi. of the original 1920 construction program will be contracted for.

Office for St. Paul Plan Board

The City Planning Board of St. Paul, Minn., has opened offices at 705 Commerce Building, with George H. Herrold in charge as managing director. The Board was created by a city ordinance, as announced in these pages recently, and is to make a study of the physical conditions and prepare a comprehensive plan for the development of the city.

California to Have American Water Works Section

The first section of the American Water Works Association to be established west of the Rocky Mountains, to be known as the California section, is now in process of formation at San Francisco.

Hetch Hetchy 18-Mile Tunnel Contract Awarded

Award of the Hetch Hetchy contract for 18.3 miles of concrete-lined tunnel having a width and height of finished section of 10 ft. 3 in., has been made on a cost-plus basis to the Construction Company of North America, which will undertake the work immediately under the general supervision of City Engineer O'Shaughnessy of San Francisco. This is the first cost-plus contract which has been entered into by the City of San Francisco and its validity will be tested in the courts before work proceeds, although no delay on this account is anticipated.

The contractor, who will be paid in Hetch Hetchy bonds at par, guarantees that the cost of the entire work will not exceed $7,803,000, this sum including his fixed fee of $1,190,000 covering both supervision and the estimated cost of financing the project. The figures are for a fully-lined tunnel as compared with figures previously announced for partial lining only.

New York To Complete Canal Terminals

Governor Smith, of New York, has signed the Sage bill, which appropriates $1,850,000 to complete the Barge Canal terminals at Buffalo, Rochester and New York City.

Annual Meeting of the Am. Soc. C. E. To Be Held in Portland

Portland, Ore., has been designated as the city in which the annual meeting of the American Society of Civil Engineers will be held Aug. 10-12. In the rotative plan whereby the annual meetings are successively held in central cities of the several regional districts, Houston, Tex., had been chosen for the meeting place for the 1920 annual meeting, and the date had been set in October. However, owing to several proposed amendments arising out of the questionnaire which was recently voted upon, the Board of Direction recommended that the meeting be held earlier than October in order that action might be secured upon the proposed amendments during 1920. As it is so warm in Houston during the summer, Portland was selected as the meeting place.

Testing Materials Meeting Program

Preliminary announcement of the program for the coming meeting of the American Society for Testing Materials has been made. The meeting will be at the New Monterey Hotel, Asbury Park, N. J., June 22-25 inclusive. Three sessions will be held on Tuesday, June 22, and Thursday, June 24, with two sessions on Wednesday and Friday. There will be an informal dance and smoker Tuesday evening, an afternoon off Wednesday and the annual golf tournament Friday afternoon. Fifty-nine papers and committee reports are scheduled on the program.

Wanaque Dam Bids Rejected

Only two bids were received for the construction of the Wanaque dam, an earth structure with concrete and clay puddle core wall, for which plans and specifications had been prepared by the North Jersey District Water Supply Commission. The contract will be re-advertised.

The two tenders received April 27 were from Rogers & Hagerty, New York, $4,826,290; and Patrick McGovern, New York, $5,572,545.

Public Contract on Cost-Plus Minus Penalty Basis

A contract has just been awarded by the Detroit Department of Health to John Finn & Son of Detroit for the construction of a new tuberculosis sanitarium, comprising a hospital group of nine buildings, on a basis somewhat novel in public works. The contractor is to receive 7 per cent of the cost provided the total cost, including the contractor's fee and excluding fixed charges, does not exceed $1,460,800. In case the cost of the work exceeds the contractor's estimate, 15 per cent of such excess will be deducted from the contractor's fee. The Health Department originally planned to build a group to cost $1,000,000. Two lump-sum bids were received, the lower of which was about 27 per cent in excess of the limit guaranteed by the same contractor after certain revisions in the plans were made.

Patent Reform Bill Passes House

Engineering Council announces that its Patent Committee has been co-operating with the Patent Committee of the National Research Council in endeavors to secure the enactment of patent legislative bills which had been formulated by the latter committee. These bills embrace four principal features: (1) Increase in the force and salaries of the Patent Office; (2) provision empowering the court to receive opinion and expert evidence to approximate a just division of profits or damages between patentees and infringements; (3) a single court of patent appeals, and (4) the making of the Patent Office independent of the Interior or any other department.

After extensive hearings the Patent Committee and the House of Representatives decided for the present only to recommend the first two of the four features, and these were combined in the Nolan bill (H.R. 11,984) introduced in the House on Jan. 22, 1920. After a number of hearings and considerable effort on the part of the various committees back of the movement the bill passed the House on March 5, 1920, and is now before the Patent Committee and the Senate. It is stated that there appears to be an excellent chance to secure the passage of the bill through the Senate, or at least that portion thereof which gives relief to the Patent Office by increasing the force and salaries.

Orville Wright To Receive John Fritz Medal

The John Fritz Medal is to be presented to Orville Wright by the John Fritz Medal Board of Award on Friday evening, May 7, in the auditorium of the Engineering Societies Building, 29 West 39th St., New York.

Hearings on Road Bills Begin

Hearings on all road bills before the Senate Committee on Postoffices and Post Roads began May 4. The principal measure to be considered, however, is the Townsend Bill.

George S. Webster for Testing Materials Head

The nominating committee of the American Society for Testing Materials has put forward the following ticket for the ensuing year: President, George S. Webster, Philadelphia; vice-president, G. K. Burgess, Washington, D. C.; members of executive committee, L. G. Blackmer, D. E. Douty, Prevost Hubbard and R. S. Whiting. Mr. Webster has been in the service of the City of Philadelphia for many years and has just returned to his old position as chief of the Bureau of Surveys.

Senate Plans to Stimulate Construction Work

Measures to stimulate construction work in all its forms are to be considered by a special committee of the Senate, headed by Senator Calder of New York. Carrying out the provisions of a resolution to the above effect, the Vice-President named the following Senators, in addition to Senator Calder, to serve on the committee: Kenyon of Iowa, Edge of New Jersey, Wolcott of Delaware, and Gay of Louisiana.

The plans of the committee have not been formulated but it is the intention to make a nation-wide and exhaustive inquiry into the building situation.

Funds for Government Surveys

The amount for topographic surveys carried in the Sundry Civil Bill, recently reported out of committee, is $330,000. The committee was inclined to allow the $600,000 which had been asked. The appropriation for the current fiscal year is $325,000. In addition $100,000 is to be allotted to the Geological Survey for military mapping. This additional amount, however, cannot be considered as being available for general work. Such surveys can be executed only where the War Department indicates. It is expected that the entire amount will be expended at one point along the South Atlantic Coast.

Conferees Agree on Water-Power Bill

Senator Jones, chairman of the Senate Commerce Committee, has announced that the House and Senate conferees had agreed on a water-power bill. The revised bill passed the House on May 4 and is now before the Senate.

Contractor's Claim Recognized

As an incident to the passage of a bill by the Senate carrying $30,843.45 for the relief of the Leavenworth Bridge Company, the chairman of the Committee on Claims stated the policy of the Committee, with regard to the relief of contractors who suffered losses due to war conditions. He said:

"The general policy of the committee is in no case to allow for a loss which the contractor might have suffered, except where the loss was occasioned either directly by the act of the Government, or was occasioned under such circumstances as made the Government responsible and where, in addition to one of those two conditions, the department of the Government under which the work was done, after examining the facts, recommended that there was such a loss as the Government, in good conscience, ought to compensate for. Where those three conditions combine in a case, the committee generally looks with favor upon it. Certainly a contractor who suffers a loss, instead of a profit under his contract, is not entitled to reimbursement.

National Academy to Have Headquarters in Washington

The National Academy of Sciences will erect a $1,400,000 building as its headquarters in Washington, according to announcement made by Dr. Charles D. Walcott, president of the Academy and the secretary of the Smithsonian Institution, at a council meeting of the Academy in Washingon April 25. The building is to be erected opposite the Lincoln Memorial in Potomac Park. The lot was purchased by the Academy through private contribution and the Carnegie Corporation of New York has granted $55,000,000 to erect the building and endow the National Research Council. The remaining $3,600,000 of the Carnegie endowment will be used as a fund to establish an income for expenses of the Academy and the National Research Council.

South American Railroad Places Contract to Electrify

Contract has been placed for American equipment for the electrification of the double-track line of the Paulista Railway Co. between Jundiahy and Campinas, Brazil, a distance of about 28 miles, representing the first main line railroad electrification in South America. It has been announced that the contract calls for nearly $2,000,000 worth of equipment, on order with the International General Electric Co. It is to consist of eight freight and four passenger locomotives and material for the transmission line, substation, and 3,000-volt overhead. The locomotives will be built at the Erie works of the General Electric Co.

The project anticipates further extension of electrification to Sao Carlos, a distance of 128 miles. The new line is expected to be in operation July, 1921.

Detroit Society Votes to Join "Comprehensive Organization"

The Detroit Engineering Society, at a meeting held April 24 and attended by more than one-half the membership of the society, voted to join the "comprehensive organization," or federation of engineering bodies, outlined in the report of the Joint Conference Committee of the four Founder Societies. The Detroit organization has 578 members.

Another Waterways Control Bill

One more bill proposing a scheme of Federal waterways control has been introduced into the House of Representatives by Mr. Rainey. This bill (H. R. 13,435) creates a National Waterways Council made up of cabinet officers and a Water Control Board consisting of a chairman to be appointed by the previously named Council and four assistant secretaries, the chairman of the Board to receive a salary of $12,000 and each assistant secretary, $10,000. The Council is to have authority to direct and control all proceedings and operations relating to the control of waterways for whatever purpose in the United States and the technical detail of such control is to be executed under the direction of the Water Control Board. A sum of $60,000,000 to be known as the "River Regulation Fund" is appropriated. The bill has been referred to the Committee on Flood Control.

League of the Southwest Considers Colorado River Control

Concerted action of all interested parties in developing storage and power possibilities on the Colorado River was the dominant note in the three-day session of the League of the Southwest, held in Los Angeles early in April. The meeting was attended by governors of five states and a large number of delegates from all parts of the Colorado River basin. Engineers were represented on the list of speakers by John T. Whistler, engineering adviser of the Federal Farm Loan Bureau; C. E. Grunsky, consulting engineer; F. E. Weymouth, chief of construction, United States Reclamation Service, and E. C. La Rue of Pasadena.

The convention unanimously adopted resolutions covering a wide range of development of Colorado River possibilities; some of the chief features of the resolutions are included in the following: Congress was requested to appropriate $50,000 for the use of the Reclamation Service in completing investigation of the Boulder Canyon Reservoir site, this project to be a combination flood protection, irrigation storage and power development plan. The abandonment of the Ouray reservoir site was recommended. Effort should be made, it was suggested, to effect some agreement with Mexico whereby there could be joint control of irrigation works in Mexico from which American properties are supplied. The governors of the states represented in the League of the Southwest were made a permanent committee to further interests held in common and a permanent engineering commission was appointed, consisting of the state engineers of the several states and engineers of the United States Reclamation Service, to prepare a comprehensive plan for immediate action and early development.

Bill Offered to Relieve New Jersey Contractors

In order to compensate contractors for losses incurred because of the war's advancing material and labor prices, a bill has been introduced into the New Jersey legislature. The bill has passed its second reading in the Senate but has not yet reached the House. It has been referred to the committee on municipal corporations. In the bill it is stipulated that only "actual and necessary costs" shall be recoverable, though this cost shall include all items of necessary and actual cost and expense entering into the performance of the work under the terms of the original contract. No profit is allowed the contractor. Recovery is made possible only upon those contracts entered into before Dec. 31, 1917, and after the declaration of war with Germany, April 6, 1917; or upon contracts entered into previous to the declaration of war, but which remained uncompleted through no fault of the contractor or through causes "which were beyond the control of the contractor." The provisions of the bill apply only to work undertaken "on behalf of the State of New Jersey, or any districts thereof, or any county, municipal corporation, borough, town, township, village or political subdivision of the State," and to costs traceable to the existence of a war with Germany.

Changes in Engineer Corps

The following changes in duty and station of officers of the Corps of Engineers, U. S. A., are announced:

Colonel H. C. Newcomer has been recalled from Hawaii for duty in the United States. He has been succeeded as department engineer for Hawaii by Colonel Clement A. F. Flagler. Colonel Flagler has been in command at Camp Humphreys. Colonel Arthur R. Ehrnbeck has been assigned as assistant to the department engineer of Hawaii.

Colonel T. H. Jackson has been appointed department engineer for the northeastern department. His headquarters are at Boston.

Colonel R. G. Alexander, who is now at the Army War College in Washington, has been ordered to West Point as professor of drawing to succeed the late Colonel E. R. Stewart.

Major Earl J. Atkisson, who has been engineer instructor at Camp Benning, has been assigned to the command of Edgewood Arsenal.

Vehicular Tunnel Bill May Be Passed Over Veto

Governor Edwards of New Jersey vetoed May 4 the bill authorizing the issuance of bonds to cover New Jersey's share in the cost of the Hudson River vehicular tunnel and the Delaware River bridge. The bill provided for a direct tax on all state property to raise the necessary $30,000,000, and will, in all probability, be passed over the Governor's veto.

To Examine Idaho Engineers

It is announced that the next examination for the licensing of engineers in Idaho will be held in the Capitol Building, Boise, September 14. An examination for surveyors at the same place is scheduled for September 7. All inquiries should be addressed to the Department of Law Enforcement, Boise, Idaho.

CIVIL SERVICE EXAMINATIONS

UNITED STATES

For United States civil service examinations listed below, apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the Civil Service Commission, for Form 1312.

Logging engineer, $2,400 to $3,000 per year. File application not later than May 11.

Structural steel draftsman and designer, $2,400 per year. File application not later than May 11.

Assistant engineer, $1,500 to $2,000 per year. File application not later than Aug. 2.

Junior engineer, $1,200 to $1,500 per year. File application not later than Aug. 2.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF ENGINEERS; 63 E. Adams St., Chicago; May 10, 11, St. Louis, Mo.

AMERICAN WATER WORKS ASSOCIATION, New York City; Montreal, June 21-26.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Asbury Park, N. J., June 22-25.

AMERICAN PUBLIC HEALTH ASSOCIATION, Boston; San Francisco, Sept. 13-17.

ORGANIZING CONFERENCE of National, State and Local engineering societies; Washington, D. C., June 3-4.

The New York Section, Am. Soc. C. E. will hold its annual meeting in the Engineering Societies Building, New York City, May 12, at 8.30 p.m. Col. Wm. J. Wilgus will talk on "The Railroad Problem in Relation to the Metropolitan District." The following names have been suggested for officers by the nominating committee: President, Wm. J. Wilgus; first vice-president, R. S. Parsons; second vice-president, J. P. H. Perry; secretary, W. T. Chevalier; treasurer, F. C. Noble; directors, O. E. Hovey and R. H. Chambers.

The California Section, American Water Works Association was organized in San Francisco April 20, and the following officers elected: Chairman, George A. Elliott, chief engineer, Spring Valley Water Co.; vice-chairman, Charles G. Hyde, professor of sanitary engineering, University of California; secretary-treasurer, George W. Pracy, superintendent, city distributing system, Spring Valley Water Co.

The Raleigh (N. C.) Engineering Society, composed of the professional engineers of that city, was organized April 19, and the following officers elected: President, H. B. Henderlite; secretary-treasurer, W. Z. Betts; chairman of committee on membership and publicity, L. P. Denmark. Membership is open to any local practicing engineer. The society expects later to affiliate with the American Association of Engineers. Its purpose is to promote the social and economic welfare of all professional engineers in the city. Meetings will be held on the first Monday of each month.

The American Public Health Association, Boston, has changed the date of its coming annual meeting at San Francisco, Calif., from Aug. 3—Sept. 3 to Sept. 13-17. This change has been necessitated by a California state election on Aug. 30.

The Southern California Association of Members, Am. Soc. C. E. held a special meeting in Los Angeles, on April 2, at which a telegram from President Davis regarding the amendments to the constitution of the society and the 1920 convention was read. After discussion of these matters, it was agreed upon by the members present that, as the board of direction had for sound reasons decided that the annual convention should be held in Houston, Tex., it was the opinion of the association that whenever the annual convention was held in District 11, it should be held in Houston, and that, apart from all other reasons, the short time available prior to August would prove a serious handicap against the proper and suitable arrangements for a convention in Los Angeles at that time. A letter from C. T. Leeds, regarding the proposed increase of pay of civilian engineers and clerks in the U. S. Engineering Department, in which Mr. Leeds requested urgent action on H. R. Bill 11892, which provides a 25 per cent increase, was read, and a telegram ordered sent to Senator Wesley L. Jones, chairman, Senate Committee on Commerce, urging fair action upon the matter, as a step in the right direction, although a 25 per cent increase was not deemed adequate.

PERSONAL NOTES

LEONARD F. AYERS, recently with the New York Central R.R., Engineering Department, at Utica, N. Y., has taken a position in the engineering department of the Colcord Coal Co., Montcoal, W. Va.

JOHN V. SPIELMAN, consulting engineer, of Russia, recently arrived at Astoria, Ore., on his way East to visit the Carthage (N. Y.) Machine Co. and other manufacturing concerns, for the purpose of buying paper-mill machinery, etc., for Russian paper mills.

ALBERT D. PAYTON has been appointed city engineer and secretary of the board of local improvements of Moline, Ill., to succeed his brother, Lyle Payton.

G. W. HARRIS, corporate engineer of the Atchison, Topeka & Santa Fe Ry. System during the period of Government control, has been appointed assistant chief engineer.

D. D. MICKEY has been appointed resident engineer of the Federal-Aid road work in Jefferson County, Kansas, with headquarters at Oskaloosa. Mr. Mickey was formerly county engineer of Geary County, Kan.

SAMUEL SCHLAU has resigned from the Liberty Iron Works and opened consulting engineering offices at 318 Greenwich St., New York City.

LAWRENCE POST, for several years with the New York Central R.R., at Watertown, N. Y., has joined the staff of the Morgan Engineering Co., Memphis, Tenn.

HENRY R. STEVENS, formerly electrical engineer with Stone & Webster, at Seattle, and more recently connected with the Fresno office of the San Joaquin Light & Power Corporation, has been appointed general superintendent in charge of the construction of the Kerckhoff power house on the San Joaquin River, Cal., succeeding W. A. Whitmire, who has been awarded a contract for driving part of the big tunnel for the Kerckhoff project.

J. M. SILLS has been appointed district engineer of the St. Louis-San Francisco Ry., at Springfield, Mo., and F. P. SWARTZ, district engineer, at Fort Worth, Tex. Division engineers have been appointed as follows: D. E. GELWIX, Springfield, Mo.; E. T. BOND, Enid, Okla.; H. F. BUSCH, Fort Scott, Kan.; J. G. TAYLOR, Memphis, Tenn.; L. L. KERNE, Chaffee, Mo.; PERRY TOPPING, Fort Smith, Ark.; T. E. BLISS, Fort Worth, Tex.; R. OWEN, acting division engineer, Sapulpa, Okla. H. B. BARRY, district engineer at Memphis, has been appointed principal assistant engineer, with office at St. Louis. C. B. SPENCER, formerly assistant district engineer in the valuation department, Interstate Commerce Commission, has been appointed valuation engineer, with office at St. Louis.

GEORGE I. SIKES, of Buffalo, N. Y., has been appointed manager of the recently organized Bradford Housing Corporation, Bradford, Pa.

A. LINCOLN FELLOWS, senior irrigation engineer, Division of Irrigation Investigations, U. S. Office of Public Roads, has been placed in charge of the Denver office of the division, with direct supervision of work throughout the Rocky Mountain region. He will also be available for consultation regarding irrigation and drainage engineering and practice.

PROF. O. M. LELAND, for the past 17 years a member of the faculty of the College of Civil Engineering, Cornell University, has become associated with the J. G. White Engineering Corporation, New York City. During the war he served as lieutenant-colonel of the 303rd Engineers, 78th Division, and after the armistice commanded the 314th Engineers, 89th Division in the entry into Germany with the Army of Occupation.

R. K. HALLETT, recently assistant engineer in charge of construction work in the field at Hercules, Cal., for the Hercules Powder Co., has been transferred to the company's plant at Carthage, Mo., as resident and maintenance engineer in charge of all maintenance, safety and construction work.

SELDEN P. SEARS has resigned as assistant engineer in the Hartford (Conn.) water department. He will be henceforth in the employ of C. W. Blakeslee & Sons, New Haven, Conn.

LUIS G. MORPHY has resigned as principal assistant engineer of the Boston & Albany R.R. to take a position with the Foundation Co. of New York as its representative in South America.

THORNDIKE SAVILLE, professor of hydraulic and sanitary engineering, University of North Carolina, has been appointed hydraulic engineer for the North Carolina Geologic and Economic Survey, and will have charge of a thorough study and investigation of the water resources of the state.

CHARLES H. RICHARDS has resigned as engineer in the valuation department of the Pacific Gas & Electric Co. at San Francisco, on appraisal of hydro-electric properties of that company, to accept a position with J. B. Lippincott of Los Angeles.

J. C. SCHWAAB, formerly assistant engineer in the valuation department of the Chicago & Alton R.R., has been appointed city engineer of Alton, Ill.

JACOB LOEWENSTEIN, for the past eighteen years engineer with the American Bridge Co., New York, has severed his connection with that company and opened an office at 347 Madison Ave., New York, as consulting engineer, furnishing service in technical knowledge and in purchase of steel for buildings, bridges and other structures.

R. F. KELKER, JR., Marshall D. Gates and Charles E. DeLeuw announce the organization of the firm of Kelker, Gates & DeLeuw, engineers, at 111 West Washington St., Chicago, and 325 Pekin St., Lincoln, Ill.

W. H. NELSON has been elected engineer of Smith County, Kan., with residence at Smith Center; G. A. RUSSELL, engineer of Geary County, at Junction City; E. H. GREEN, engineer of Pawnee County, at Larned, and W. R. SCHREINER of Sumner County, at Wellington, Kan.

R. E. J. SUMMERS, formerly captain of engineers, with the 15th U. S. Engineers, has resigned as assistant engineer on design and estimates of McClintic-Marshall Co., Pittsburgh, to become structural engineer for the H. K. Ferguson Co., engineers and builders, Cleveland

LLOYD W. STRAYER has resigned as division engineer of the Baltimore & Ohio R.R. to become associated with the Johnson Limestone Co., New Castle, Pa.

GEORGE H. BAYLES has left Morgantown, W. Va., to become chief engineer and superintendent of construction of the A. J. Krebs Co., builders, Atlanta, Ga.

EDWIN J. BEUGLER, recently consulting engineer of Westinghouse, Church, Kerr & Co., has become associated with the Foundation Co., New York, as vice-president in charge of engineering.

JOSEPH H. O'BRIEN has severed his connection with the Central Construction Corporation of Harrisburg, Pa., to become chief engineer of the Foundation Co., New York.

ROBERT S. WAIT has resigned as city engineer of Norwich, N. Y.

BUSINESS NOTES

JONES & SMART, general contractors and builders, Houston and Ranger, Tex., announce the establishment of offices and general material yards for builders' supplies at Dallas, Tex.

D. C. REEVES, recently tractor sales manager of the J. I. Case Plow Works, at Racine, Wis., has joined the Holt Manufacturing Co., Inc., Peoria, Ill., as domestic sales manager.

THE OXWELD ACETYLENE CO., Newark, N. J., and Chicago, has recently extended its manufacture of oxy-acetylene apparatus and equipment to include "Eveready" welding and cutting outfits.

JOSEPH T. RYERSON & SON, Chicago and New York, will henceforth be the sales representatives of the Camden (N. J.) Iron Works for its hydraulic machinery products.

THE RUST ENGINEERING CO., Pittsburgh, announces that the partnership consisting of S. M. Rust, of Pittsburgh, E. J. Lee Rust, of Birmingham, and E. M. Rust, of Washington, D. C., has been dissolved. The business will hereafter be carried on by the Rust Engineering Co., of Pittsburgh, the Rust Engineering Co. of Washington, and the Rust Engineering Co. of Birmingham, Ala. The business of the new corporations will be managed by boards of directors, of which the three former partners will form a majority in each case, and the business policy of the partnership will be continued in operation by the corporations which have replaced it.

H. C. PASTORIUS, for 20 years connected with the Central Railroad of New Jersey, is now associated with the Emanuel Slag Co., Allentown, Pa., in charge of that company's sales and traffic.

M. C. W. BOYD has resigned as manager of sales of the Heltzel Steel Form & Iron Co., Warren, Ohio, although retaining his official connection with the company. He will henceforth be general manager and treasurer of the Good Roads Corporation, of Kansas City, Mo., manufacturer of high-pressure atomizing road oilers, power flushers, power spreaders of tar and bituminous materials. W. J. Savage has been appointed director of sales in charge of the steel form department, and E. V. Ford will be in charge of Parrish templates and finishing machines, of the Heltzel Co.

THE MITCHELL-RAND MANUFACTURING CO., New York, is now putting out the structural compounds that it formerly made for the Universal Compound Co., taking contracts for the application of the materials in waterproofing and damp-proofing work. The Universal Co. has discontinued operations. E. A. Oldershaw, who has been engaged in the structural paint and waterproofing line for over 15 years, is in charge of the waterproofing department and will give his entire attention to this branch of the business of the Mitchell-Rand Co.

L. V. JAMES, with James B. Clow & Sons, Detroit, has entered the employ of the Bryan-Marsh Division, National Lamp Works, General Electric Co., at Chicago.

THE CONNECTICUT CONSTRUCTION CORPORATION, Meriden, Conn., owing to the confusion of that firm with other companies bearing similar names, has changed its name to Robinson & Powers, Inc.

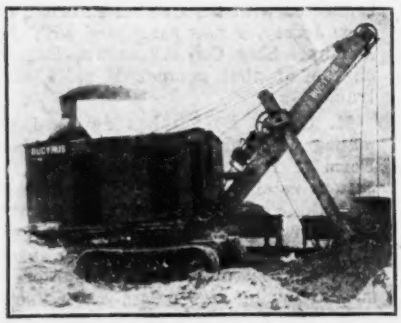
E. F. GASSEL, formerly construction superintendent, Power Construction Co., Worcester, Mass., is now holding a similar position in the Massachusetts Oil Refining Co., East Braintree, Mass.

ROWLAND G. RICE and ROBERT S. JONES, formerly with the F. W. Mark Construction Co., Inc., have organized the Rice-Jones Co., with offices at 10,600 Euclid Ave., Cleveland. The new firm will handle general building construction.

THE CAMBRIA STEEL CO., Johnstown, Pa., has promoted D. S. Muckley from superintendent of wire mill to superintendent of the Gautier department, and H. H. Phillips has been promoted to wire mill superintendent.

Convertible Excavator and Crane

A revolving steam shovel which can be rigged for various kinds of work, and can be converted readily into a dragline or grab-bucket excavator or a locomotive crane, is the latest machine put out by the Bucyrus Co., Milwaukee, Wis., for construction and industrial work. It operates ordinarily a 1-yd. or ¾-yd, dipper, the latter with a 24-ft. or

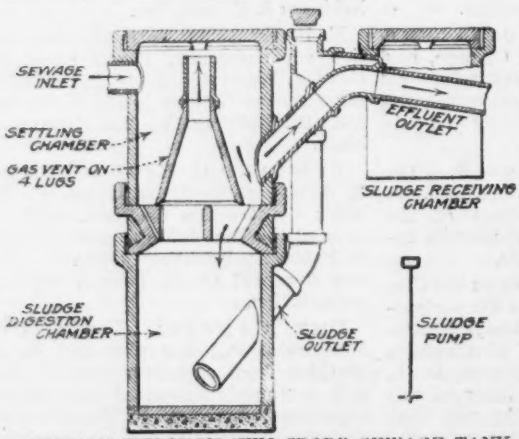


CONVERTIBLE EXCAVATOR RIGGED AS STEAM SHOVEL

30-ft. dipper handle for deep trenching, while for high lifts from deep pits the machine may have a 26-ft. boom and 17-ft. dipper handle. No bail is used, the hoisting block being attached to the back of the dipper by a pin connection. For use as a dragline or grab-bucket excavator a 35-ft. or 40-ft. boom is mounted for buckets of 1 yd. and ¾-yd. respectively. As a crane, the lifting capacity is about 10 tons on a reach of 20 ft. In working order the machine weighs about 30 tons on road or railway wheels and 34 tons on tractions of the caterpillar type. The tractions are driven by direct gearing.

Ready-Made Vitrified Clay Two-Story Septic Tank

A two-story or imhoff tank for sewage clarification and sludge digestion has been put on the market by the Ferguson Segment Block Co., St. Louis, Mo. The design and operation of the tank is shown by the sketch. The hand pump is used only at intervals. Meanwhile the cover is applied to the top of the sludge discharge pipe.

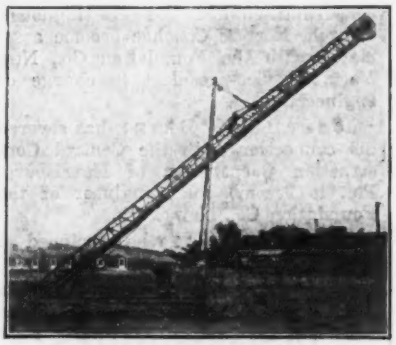


SECTION THROUGH TWO-STORY SEWAGE TANK

Chain Conveyor Delivers Concrete to the Forms

The delivery of concrete to the forms by means of a portable conveyor is a method which has been used in the construction of concrete buildings at Cleveland, Ohio, and elsewhere. The machine, shown in the accompanying view, consists of a steel frame mounted on wheels and having pivoted to one end a 42-ft. box-lattice boom in which the conveyor travels, the upper end of the boom being suspended from the head of an A-frame. A gasoline engine drives the conveyor, which is an endless chain fitted with flights or blades and having a speed of about 175 ft. per min. Concrete is spouted from the mixer to a boot or hopper on one side of the foot of the boom.

This system is considered especially applicable to work spread over a considerable area and having a height not exceeding 25 ft. The machine can be moved readily from place to place and is ready for use as soon as it is in position, thus eliminating much delay. Its range may be increased by attaching a



ADJUSTABLE CONCRETE CONVEYOR MOUNTED ON CARRIAGE

spout to the head of the boom. In constructing an addition to the plant of the Barber-Greene Co., at Aurora, Ill., it was estimated that 50 cu.yd. per 8-hr. day could be placed. The machine is handled by the Hydraulic Steelcraft Co., Cleveland, Ohio.

A New Excavator

The New Model K Excavator and loader manufactured by the T. L. Smith Company of Milwaukee, Wis., is a portable dragline filling the big gap between the steam shovel and the gang of hand shovelers. The machine stays on the ground level and draws the dirt to it. It therefore eliminates the building of trestles, which is a necessity accompanying digging devices which "go down into the hole." After the work is finished, the excavator can be moved on to the next job just as easily and quickly as a wagon.

Two men operate this machine—one at the operating levers and one at the loading point. At a point anywhere within 50 to 200 ft. from the machine is stretched a chain, at right angles to the line of digging; upon this chain are two sheaves, hooked to the chain, either sheave may be unhooked and re-located in an instant. One heavy cable passes from the hoist drum on the machine, then to the digging skip,

NEW DRAGLINE DRAWS MATERIAL TO LOADING POINT

then through both sheaves, back to the retrieving hoist drum on the machine. The operator at the machine manipulates two levers and a foot brake. As he places power on the digging line, the other man manipulates the handles, on the slip, so as to fill it with the material to be dug or removed. The slip has a capacity of 15 cu.ft. per trip. As soon as the slip is filled, the man releases the handles and allows the slip to ride to the excavator. As the slip strikes the apron at the machine it unlocks the catch of the pivot arm on the machine. The arm then carries the slip up over the machine and onto a slanting chute located on the front of the machine, whence the material in the slip discharges into the waiting wagon, truck or railroad car. The slip is then quickly retrieved to the starting point and the operation repeated.

Turner Company Constructed 75 Industrial Buildings in 1919

Statistics compiled recently by the Turner Construction Co., of New York City, indicate that during 1919 that organization's forces erected 75 industrial buildings, 25 concrete workmen's homes, and 20 miscellaneous concrete structures for oil refinery purposes. Of the 75 factories and warehouses, 62 were five stories and less in height and the average total floor area per building was 62,046 sq.ft. While these figures indicate that the majority of the work was on average size buildings, the company has had on hand at various times 19 jobs in excess of $1,000,000 in cost.

North Carolina Highway Commission to Issue Monthly Bulletin

Beginning with April the North Carolina State Highway Commission publishes a monthly highway bulletin embodying a digest of the progress of all road work in the state.